

Assessments to Determine the Effect of Current and Alternate Ladder Operations on
Brood Stock Collection and Behavior of Hatchery Fall Chinook Salmon at Little White
Salmon National Fish Hatchery During 2004-05

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Assessment Objectives:

Objective 1. Determine if hatchery brood stock collection is representative of the hatchery return.

Objective 2. Determine if intermittent ladder openings increase natural spawning and straying of Little White Salmon National Fish Hatchery returning adults.

Objective 3. Determine the final destination of fish not allowed access to the hatchery or selected for brood stock.

Background – Little White Salmon National Fish Hatchery

Production of upriver bright fall Chinook salmon at Little White Salmon National Fish Hatchery (LWSNFH) was introduced as part of the John Day Dam mitigation program in the early 1980s. Upriver bright fall Chinook salmon are not native to the Little White Salmon River basin and are an introduced stock for the Lower Columbia River Chinook Evolutionary Significant Unit, as listed under the Endangered Species Act. There is concern regarding potential ecological effects, especially hatchery introgression effects, if wide spread straying of this stock occurs in the Columbia River (USFWS 2004).

Returns of upriver bright fall Chinook salmon to the LWSNFH have historically exceeded annual adult escapement goals (CRiS 2005). Upriver bright fall Chinook produced by LWSNFH and coho salmon produced by Willard NFH returned simultaneously for the past several years. Willard NFH¹ is a satellite facility of LWSNFH and located 4 miles upstream on the Little White Salmon River. LWSNFH

¹Due to budget shortfalls with Mitchell Act funded programs by NOAA Fisheries, the on-station release of coho salmon from Willard NFH was terminated with brood year 2002 released early in January 2004.

staff adopted the practice of restricted ladder operations during the mid-1990's to prevent excess fish from returning to the hatchery adult holding ponds and continued the operations during the newly instituted tribal fishery for upriver bright fall Chinook salmon in Drano Lake. Ladder openings are very short in duration due to the large numbers of coho salmon and upriver bright fall Chinook salmon that congregate in front of the hatchery ladder. Once the hatchery escapement goal of 2000 upriver bright fall Chinook salmon and the subsistence needs of the Yakama Nation are met, the ladder is closed.

The issue of surplus hatchery brood stock can be a contentious issue. A negative public perception exists of hatchery fish being euthanized when numerous wild runs were depressed or protected by the Endangered Species Act. Additionally, the euthanasia of adult salmon by "clubbing" can also be seen negatively by the public. Leaving excess fish in the Little White Salmon River can prove beneficial to both sport and tribal fisheries that occur in Drano Lake, where the Little White Salmon River enters the Columbia River. All of these factors led to the decision to restrict ladder operation to limit the number of fish entering the hatchery.

Upriver bright fall Chinook salmon are left in the Little White Salmon River for natural spawning, consumption by wildlife and stream nutrient enhancement from carcass decomposition. A historic barrier to anadromous fish passage limits natural spawning activity in the Little White Salmon River but some small, marginal-quality spawning gravel exist below the barrier, near the hatchery (USFWS 2004). Carcasses remaining in the river and Drano Lake are believed to be extremely beneficial to local wildlife and the Columbia River ecosystem. As a result, the hatchery has become a popular wildlife viewing area due to an active bald eagle roost and the intense use of the area by wintering bald eagles (USFWS 2004).

During fall 2004 and 2005, an assessment was initiated to verify that current brood stock collection activities were representative of the hatchery return and to document behavior of individual fish not allowed access to the hatchery. The following objectives were identified for the 2004-05 ladder assessment:

Objective 1. Determine if hatchery brood stock collection is representative of the hatchery return.

Objective 2. Determine if intermittent ladder openings increase natural spawning and straying of Little White Salmon National Fish Hatchery returning adults.

Objective 3. Determine the final destination of fish not allowed access to the hatchery or selected for brood stock.

Assessment Methods

Ladder Operations differed between 2004 and 2005. For the 2004 upriver bright fall Chinook salmon return, ladder operation at LWSNFH was not changed from the previous

three return years (2001-2003). Brood stock collection occurred during periodic openings of the adult ladder throughout October and early November, usually 10 to 20 minutes per opening, throughout the upriver bright fall Chinook salmon return. In 2005 ladder operation was amended through discussions with NOAA- Fisheries and Service staff. The operation of the adult ladder agreed upon by both agencies was intermittent openings up until the third tribal fishing date, October 19th, and then the adult ladder was to remain open for the remainder of the upriver bright fall Chinook salmon return. Small ladder closures lasting between minutes to a few hours did occur after October 19th during directed spawning and surplus operations in brood stock ponds. These closures are considered normal operating protocol for spawning and surplus activities.

To assess study objectives, upriver bright fall Chinook salmon were captured for tagging at the ladder entrance using a long-handled 1.0 m diameter dip net during the hatchery return. In 2004, fish were captured prior to and during hatchery ladder openings. In 2005, all fish were captured during ladder closures and opening that occurred prior to the 3rd tribal fishing closure on Drano Lake, which was October 19th, 2005. Captured fish were anesthetized and tagged with an individually numbered fluorescent pink Petersen disc tag placed near the dorsal fin on one side of the fish with a blank tag used as backing on the opposite side of the fish (Figure 1). Radio transmitters were also attached to a portion of fish from each tag group in 2004 to document behavior. In 2005, all captured upriver bright fall Chinook salmon received a radio tag. All captured upriver bright fall Chinook salmon were allowed to recover from anesthesia and released into the Little White Salmon River spillway adjacent to the ladder opening.

Recovery of tagged upriver bright fall Chinook salmon occurred three ways; hatchery recoveries, spawning ground recoveries, or angler recoveries. Recovery of tagged fish at the hatchery occurred when fish navigated the ladder during an opening when hatchery brood stock was being collected or fish were being surplused. Tags and radio transmitters were recovered by hatchery staff. Upriver bright spawning ground surveys are routinely conducted by Washington Department of Fish and Wildlife (WDFW) and Pacific States Marine Fisheries Commission (PSMFC) staff on the Wind River, the White Salmon River, and the Little White Salmon River/Drano Lake areas (Figure 2). Surveys are routinely conducted weekly during November and the first week of December 2004 and 2005. When spawning survey crews would encounter a tagged fish as a carcass, the tag would be removed and the recovery location and date were passed on to Service staff. Angler recoveries occurred when a sport or tribal angler would capture a tagged fish during regular fishing activities. There is a tribal gillnet fishery that occurs in Drano Lake, adjacent to the hatchery and the source of entry of the Little White Salmon River (Figure 3). The fishery occurred the first three Wednesdays of October during the upriver bright fall Chinook salmon return in 2004 and 2005. Sport anglers were present in Drano Lake during periods of the return when tribal gillnet fisheries were not in effect. Sport and tribal fisherman in the area of the Columbia River Gorge were encouraged to report any tagged fall Chinook captured through informative flyers placed at tribal and sport fishing boat ramps, and at bank fishing sites in addition to the tag reporting information printed on the disc tags.

Upriver bright fall Chinook salmon with radio transmitters were monitored by mobile tracking and by a fixed receiver located at the confluence of the Little White Salmon River and Drano Lake. In 2005, an additional fixed receiver was placed across the lake from the public parking lot used by bank fisherman (Figure 3). Mobile tracking of radio transmitters occurred weekly with a search pattern of LWSNFH, Drano Lake, the White Salmon River below Condit Dam, 2 miles upriver of the Hood River Toll Bridge, the lower 2 miles of Hood River, and the Washington shore of the Columbia River down to the Wind River.

During the last two weeks of November and one week in December an extended mobile tracking effort was made on the Columbia River from Hamilton Island at river mile 144 to the mouth of the Deschutes River, river mile 204. When a radio transmitter signal was detected in a tributary of the Columbia River, a visual verification of the tagged fish was attempted and the location of the fish was recorded. If the tag was not recoverable and didn't move from the location during this period it was considered an observed recovery. Fixed receivers at Drano Lake were checked weekly for recorded movements of fish with radio transmitters.

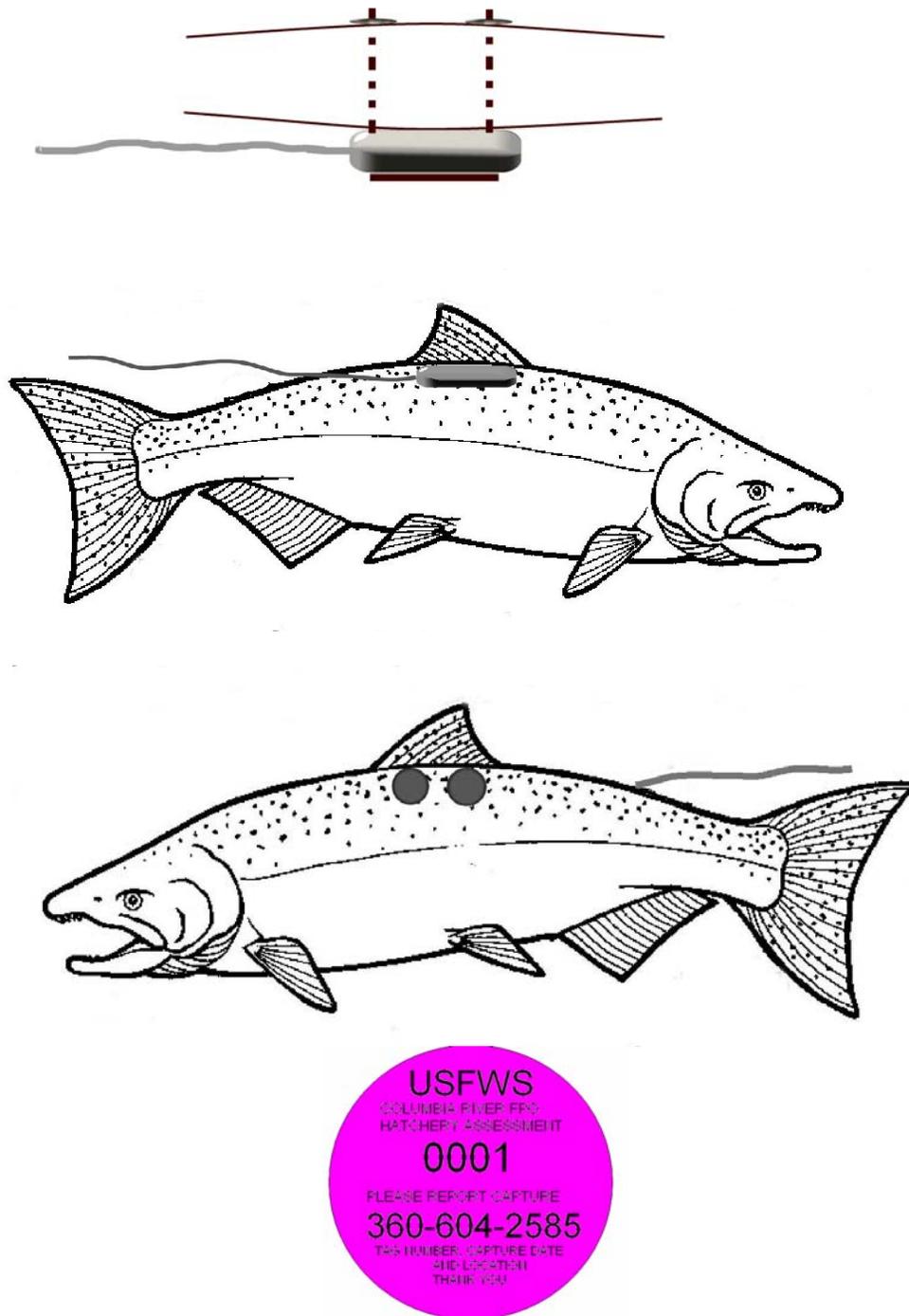


Figure 1. Attachment of radio transmitters using nickel pins and Petersen disc tags shown dorsally and ventrally. The top illustration (dorsal view) shows a horizontal cross-section of the tag placement. Fish tagged without radio transmitters (disc tags only) had only one Petersen disc on each side with tag reporting information printed on one side. Illustrations are by David Hand (USFWS).

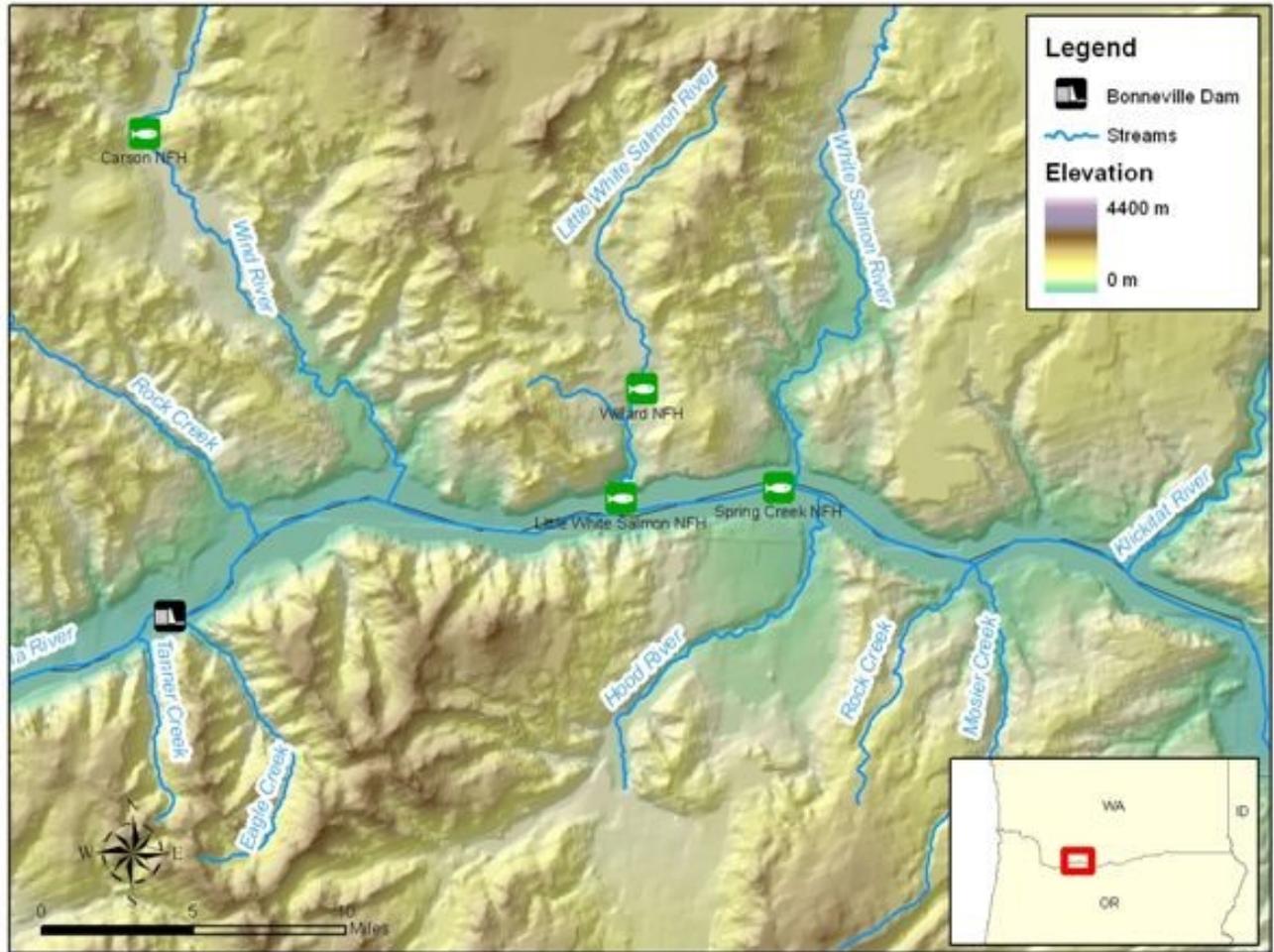


Figure 2. Map of recovery locations within the Columbia River Gorge. The states of Washington and Oregon are separated by the Columbia River. Carson, Spring Creek and Willard National Fish Hatcheries are also identified. Map made by David Hines (USFWS).

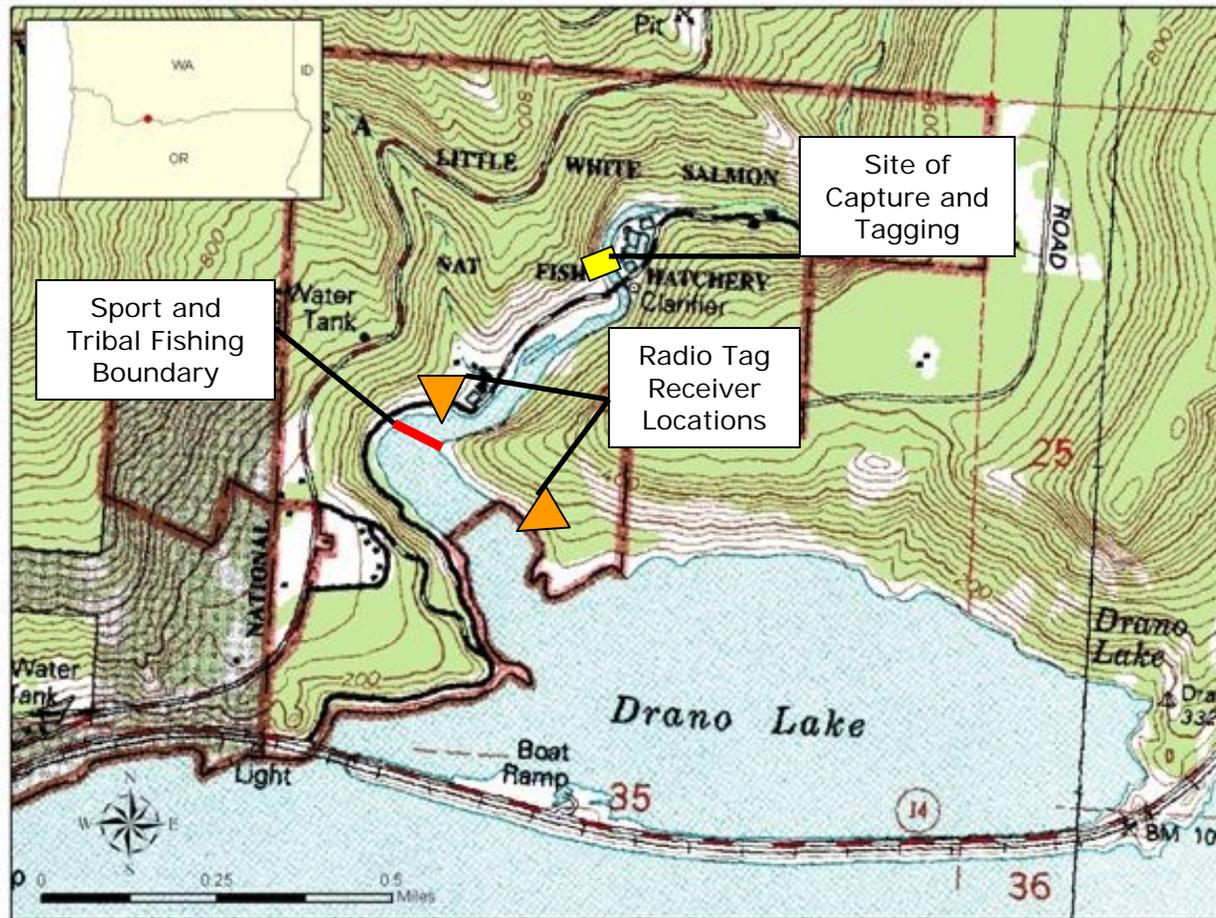


Figure 3. Map of Drano Lake, WA. The barrier dam to Little White Salmon Hatchery is the site of capture and tagging of upriver bright fall Chinook salmon. The radio telemetry receiver locations and sport and tribal fishing boundary are all shown. The connection of Drano Lake to the Columbia River occurs in the southwestern corner of Drano Lake. Map made by David Hines (USFWS).

Results – 2004 Ladder Operations Assessment

Ladder openings occurred on seven days totaling just over 2.5 hours during 2004 (Figure 4, Table 1). During these openings there was a total number of 2,653 upriver bright fall Chinook salmon and 6,251 coho salmon collected during ladder openings. Coho salmon were often placed back into the White Salmon River, or recycled, by hatchery staff when collected during ladder openings.

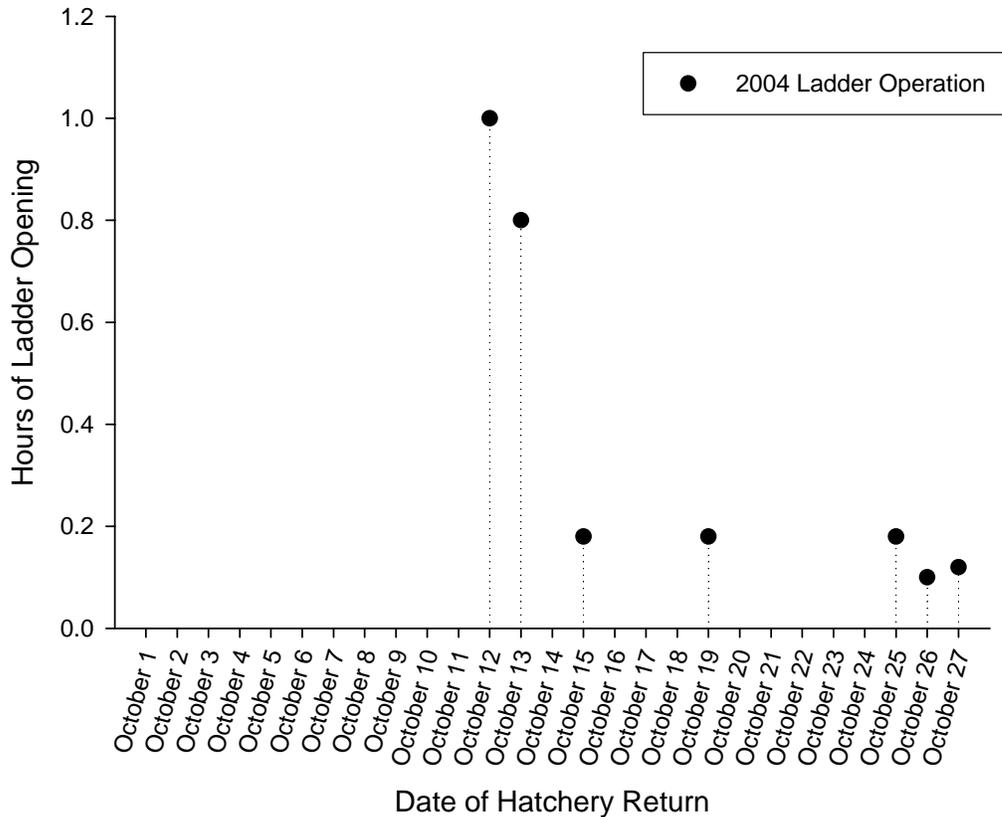


Figure 4. Hours of ladder operation at LWSNFH during the 2004 hatchery return of upriver bright fall Chinook salmon. Hours the adult ladder was open are plotted against the date of return.

Table 1. Date, duration, and time of ladder openings for LWSNFH during the 2004 ladder operations assessment.

Date of Opening	Duration	Time of Day
October 12	60 minutes	12:20 – 13:20
October 13	50 minutes	8:50 – 9:30 15:30-15:40
October 15	20 minutes	10:25 – 10:35 15:00 – 15:10
October 19	10 minutes	14:10 – 14:20
October 25	10 minutes	14:35 – 14:45
October 26	6 minutes	14:30 – 14:36
October 27	8 minutes	10:00 – 10:08

A total of 253 upriver bright fall Chinook salmon were tagged over three different tag groups, on six different occasions during October 2004 (Table 2). A total of 45 tagged fish were recovered by several agencies and at several locations throughout the Columbia River Gorge tributaries (Table 3). A total of 17 fish that were tagged during the assessment were recovered by hatchery staff during brood stock spawning activities. No recoveries were reported from the October 30th tag group since the ladder was closed by that date. Recoveries at the hatchery were not sufficient to determine if the hatchery representatively selected brood stock throughout their return. A statistical power of 0.7

Table 2. Date of tagging, number tagged, and number recovered of three groups of upriver bright fall Chinook salmon tagged during the LWSNFH return. The number in parentheses is the number of tagged fish with radio transmitters. Total recovered includes hatchery brood stock recoveries.

Tag Date	Group	Number Tagged (radio transmitters)	Hatchery Brood Stock Recoveries	Total Recovered
10/12	Green	24 (4)	2	4
10/14	Green	40 (5)	2	5
10/15	Green	50 (5)	7	13
10/20	Yellow	50 (5)	5	11
10/21	Yellow	42 (5)	1	7
10/30	Red	47 (15)	0	5
Total		253 (39)	17	45

Table 3. Recovery locations, number of tagged fish recovered, and agency or person who recovered tagged fish from LWSNFH during the 2004 upriver bright fall Chinook salmon run.

Recovery Location	Recovered	Recovered By
Bonneville Hatchery	2	Oregon Dept. of Fish and Wildlife
Drano Lake	1	Yakama Tribal Fisherman
Columbia River	1	Sport Angler
Deschutes River	1	Confederated Tribes of the Warm Springs Reservation of Oregon
Eagle Creek (Col. River Gorge)	1	U.S. Forest Service
Hamilton Island	1	Washington Department of Fish and Wildlife (WDFW)
Hamilton Springs	1	WDFW
Little White Salmon National Fish Hatchery	17	U.S. Fish and Wildlife Service (USFWS)
Little White Salmon/Drano Lake	4	WDFW and USFWS
White Salmon River	14	WDFW and USFWS
Wind River	2	WDFW

or greater was desired for the chi-square test to determine the representative collection objective but a power of only 0.2 was achieved with the data collected. A total of 21 of the 45 (47%) tags were recovered at the hatchery or the Little White Salmon River/Drano Lake area. The White Salmon River had 14 of the 45 (31%) recovered upriver bright fall Chinook salmon.

The number of salmon captured by the tribal gillnet fishery in Drano Lake was 3,496 adult Chinook salmon, 75 Chinook salmon jacks, and 1,357 coho salmon (Roger Dick Jr., Yakama Nation, November 2004 personal communication). One tagged fish from the assessment was captured in the tribal fishery. There were no tags reported by anglers during the sport fishery in Drano Lake but one recovery was reported by an angler near Cascade Locks in the Columbia River. Estimated sport angler catch of fall Chinook salmon in Drano Lake during 2004 was 625 adults and 25 jacks (Joe Hymer, Washington Department of Fish and Wildlife, Vancouver, WA, personal communication). These estimates are based on limited sampling and escapement returns.

Table 4. Number of Chinook salmon and coho salmon captured during October 2004 in the Drano Lake tribal gillnet fishery. Numbers reported by Roger Dick Jr., Yakama Nation during November 2004.

Date of Fishery	Chinook Salmon	Chinook Salmon Jacks	Coho Salmon
October 5	1,918	49	270
October 12	1,141	5	516
October 19	437	21	571
Total	3,496	75	1,357

Mobile tracking of upriver bright tule fall Chinook salmon found that a large proportion of fish left the immediate hatchery area by November 15th, 2004 (Table 5). Only 24 of the 40 radio tags could be accounted for at the end of radio tracking on December 6, 2004. Most radio tagged upriver bright fall Chinook salmon moved from the hatchery after October 24th (Figure 5) or by early November, dependent on tag date.

Table 5. Movement of radio-tagged fish in Little White Salmon River during 2004. Abbreviations are H (*Hatchery Area including Little White Salmon River*), Drano L (*Drano Lake*), WS (*White Salmon*), Columbia (*Columbia River*), WR (*Wind River*), HR (*Hood River*), Herm C (*Herman Creek*).

Tag Number	Tag Date	Tracking location						Final 12/06
		10/18	10/25	11/4	11/15	11/22	11/30	
112	10/12	H	H	?	?	?	?	?
133	10/12	H	Drano L	WS	WS	?	?	?
140	10/12	H	H	Drano L	Drano L	?	Columbia	Columbia
168	10/12	H	H	?	H	H	?	H
173	10/12	H	H	H	WR	WR	WR	WR
211	10/13	H	H	?	?	?	?	?
229	10/13	DL	?	?	?	?	?	?
254	10/13	H	H	HR	?	?	?	?
255	10/13	H	H	?	Herm C	Herm C	Herm C	Herm C
285	10/13	H	WS	WS	WS	WS	WS	WS
205	10/15	H	WS	?	?	?	?	?
216	10/15	H	H	?	H	H	H	H
266	10/15	H	H	Recover				
278	10/15	H	H	?	?	Eagle Cr	Eagle Cr	?
284	10/15	H	WS	WS	WS	WS	WS	WS
302	10/20		H	H	Drano L	Drano L	Drano L	Drano L
333	10/20		?	?	?	?	?	?
352	10/20		H	H	HR	?	?	?
376	10/20		WS	?	WS	WS	WS	WS
393	10/20		H	H	H	H	H	H
331	10/21		H	Recover				
349	10/21		H	H	Drano L	Drano L	H	H
370	10/21		H	Drano L	?	?	?	?
377	10/21		Drano L	?	Recover			
378	10/21		?	?	H	H	H	H
305	10/30			?	DL	?	?	?
307	10/30			?	?	?	?	?
332	10/30			H	HR	HR	HR	HR
344	10/30			?	?	?	?	?
358	10/30			?	WS	Recover		
364	10/30			Drano L	Drano L	Recover		
365	10/30			Drano L	?	?	?	?
382	10/30			H	WS	?	?	?
390	10/30			H	Drano L	Drano L	Drano L	Drano L
396	10/30			?	WS	?	?	?
421	10/30			H	?	WS	WS	WS
426	10/30			H	Columbia	Columbia	Columbia	Columbia
434	10/30			H	WS	WS	WS	WS
435	10/30			H	WR	WR	WR	WR
439	10/30			H	Recover			

**Recorded Movements of Upriver Bright Fall Chinook With
Radio Transmitters From Little White Salmon NFH During 2004 (n=39).
Radio Telemetry Station Near LWSNFH Fishing Boundary at Drano Lake, WA.**

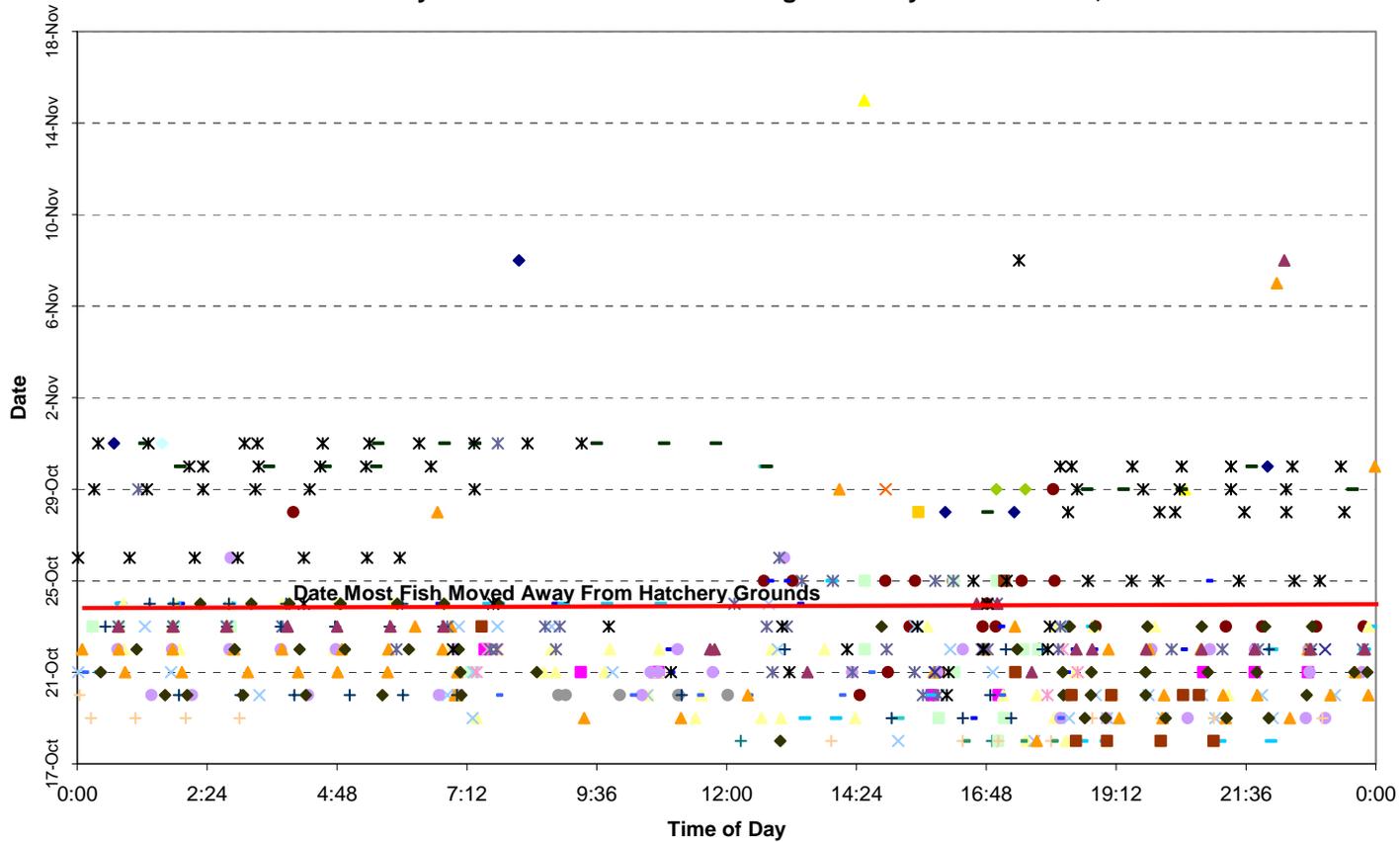


Figure 5. Recorded movements of individual upriver bright fall Chinook salmon with radio transmitters tagged at LWSNFH during 2004 plotted against time of day (n=39). The radio telemetry station was located on LWSNFH property adjacent to the sport and tribal fishing boundary on Drano Lake, WA. The date most tagged fish moved from the hatchery grounds is identified.

Results – 2005 Ladder Operations Assessment

Ladder operations in 2005 were significantly changed from 2004. Initially, NOAA-Fisheries requested the ladder operation to be open continuously for the 2005 upriver bright fall Chinook salmon return. In lieu of unknown impacts a change in ladder operation would have on the fall tribal fishery, an agreement between the Service and NOAA-Fisheries was met. The Service and NOAA-Fisheries agreed to ladder openings occurring as usual until October 19th, the day following the third tribal fishing event in Drano Lake (Figure 6). After October 19th the ladder would be open except during regular surplus, spawning and maintenance operations. The adult ladder was open 557 hours over 33 days of operation. Little White Salmon NFH collected 2,305 upriver bright fall Chinook salmon for brood stock and surplused 5,453.

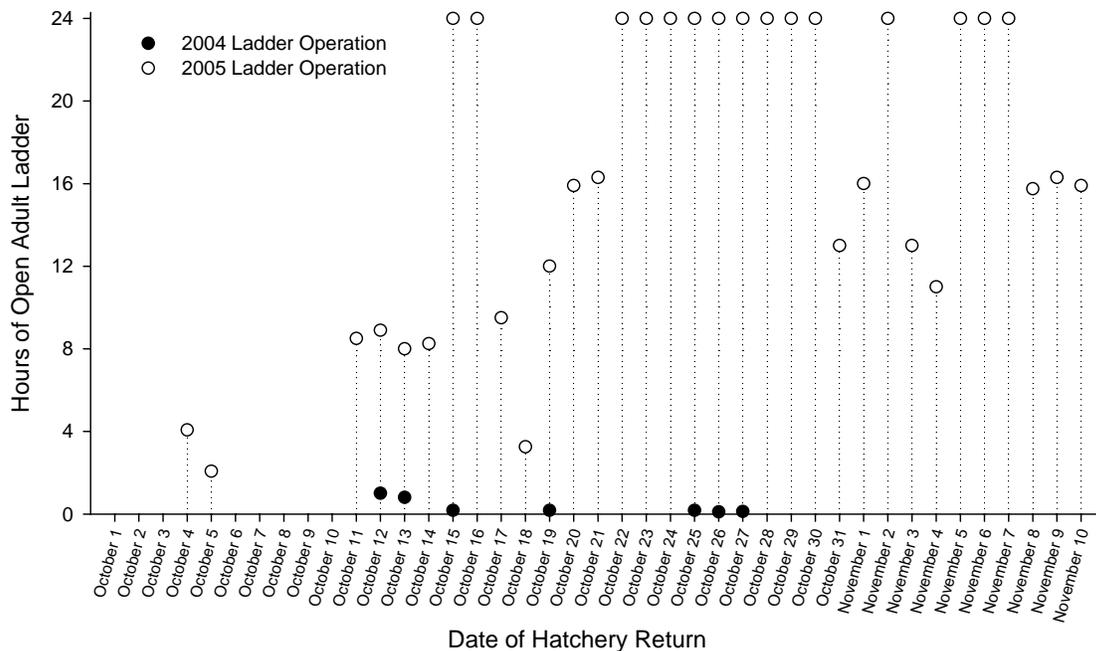


Figure 6. Hours of ladder operation at LWSNFH during 2004 and 2005. Hours the adult ladder was open are plotted against the date of return.

The hatchery return in 2005 was later than 2004 resulting in a difficulty capturing and tagging upriver bright fall Chinook salmon for the study. As of October 19th, the total number of hatchery returns was estimated at 850 fish, of which most moved into the hatchery brood ponds immediately prior to, or on that date. Only 35 fish were captured in 2005 prior to October 19th and all received radio transmitters.

Recoveries of tagged fish at the hatchery seemed consistent across tag dates with 21 of the 35 tags recovered as brood stock recoveries (Table 6). Observed recoveries occurred at Bonneville Hatchery, the Wind River, the White Salmon River and within Drano Lake (Table 7). Tribal harvest was 3,866 fall Chinook salmon and 424 coho salmon in 2005. One fish with a radio transmitter was captured and recorded by a tribal fisherman in 2005 (Table 8). A total of 668 adults and 38 jack fall Chinook salmon were caught by sport anglers in Drano Lake during 2005 based on preliminary Catch Record Card estimates

(Joe Hymer, Washington Department of Fish and Wildlife, Vancouver, WA, personal communication). A total of 7 tagged fish were not recovered and the final destination could not be determined within the period of radio tracking (Table 9).

Table 6. Date of tagging, number tagged, and number recovered at LWSNFH and total recovered from tag group. The total recovered column accounts for fish that were logged via radio transmitter at the end of radio tracking through November 7, 2005.

Tag Date	Number Tagged (radio transmitters)	Hatchery Brood Stock Recoveries	Total Recovered Including Observed Recoveries
10/11	6	3	4
10/13	4	3	3
10/14	3	3	3
10/15	11	5	8
10/16	3	1	2
10/17	8	6	8
TOTAL	35	21	28

Table 7. Observed recoveries of upriver bright fall Chinook salmon tagged with radio transmitters in 2005. The final locations of fish were based on radio tracking through November 7, 2005. The ladder at Little White NFH was closed November 10th, 2005 at the end of the hatchery return.

Recovery Location	Number of Tagged Fish	Observed or Recovered by
Bonneville Hatchery	1	USFWS Radio Telemetry Crew
Drano Lake Tribal Fishery	1	Tribal Fisherman
Drano Lake	1	USFWS Radio Telemetry Crew
Little White Salmon National Fish Hatchery	23	USFWS Hatchery Staff
White Salmon River	1	USFWS Radio Telemetry
Wind River	1	USFWS Radio

Table 8. Number of Chinook salmon and coho salmon captured during October 2005 in the Drano Lake tribal gillnet fishery. Numbers reported by Roger Dick Jr., Yakama Nation, during November 2005.

Date of Fishery	Chinook Salmon	Coho Salmon
October 5	1,626	51
October 12	1,286	130
October 19	974	243
Total	3,866	424

Table 9. Movement of radio-tagged upriver bright fall Chinook salmon from LWSNFH during 2005. Abbreviations are H (*Hatchery Area including Little White Salmon River*), Drano (*Drano Lake*), TF (*Tribal Fishery on Drano Lake*), WS (*White Salmon*), BH (*Bonneville Hatchery*), WR (*Wind River*) and R- denoting a recovery, or observed recovery, at a certain location. For example, a recovery at the hatchery would be denoted as R-H.

Tag Number	Date	Tag 10/13	10/17	Tracking location			Final	
				10/19-20	10/25	10/27	11/3	11/07
200-20	10/11	R-TF						
200-23	10/11	Drano	?	R-H				
200-26	10/11	H	R-H					
200-27	10/11	?	?	?	?	?	?	?
320-112	10/11	?	H	H	Drano	Drano	Drano	?
320-115	10/11	R-H						
340-28	10/13	H	R-H					
320-116	10/13	H	Drano	H	?	?	?	?
340-22	10/13	H	R-H					
200-26	10/13	H	R-H					
380-36	10/14		R-H					
320-110	10/14		Drano	H	R-H			
340-25	10/14		R-H					
380-37	10/15		Drano	H	R-H			
340-23	10/15		Drano	R-H				
340-21	10/15		Drano	H	R-H			
200-21	10/15		Drano	H	?	?	?	?
200-24	10/15		Drano	Drano	H	H	H	?
200-25	10/15		?	?	Drano	Drano	Drano	Drano
200-28	10/15		R-H					
320-111	10/15		?	?	R-BH			
320-118	10/15		Drano	H	?	?	?	?
320-114	10/15		?	H	R-H			
340-20	10/15		Drano	H	R-H			
320-113	10/16		Drano	H	Drano	H	R-H	
380-33	10/16		Drano	Drano	Drano	WR	R-WR	
320-117	10/16		Drano	Drano	?	?	?	?
380-30	10/17			R-H				
200-22	10/17			Drano	R-H			
380-32	10/17			Drano	R-H			
380-31	10/17			?	R-H			
340-26	10/17			?	Drano	WS	WS	WS
380-35	10/17			R-H				
380-34	10/17			R-H				
340-24	10/17			R-H				

Of the 35 total tagged upriver bright fall Chinook salmon, 23 were detected at the hatchery receiver near the fishing boundary and at the receiver on Drano Lake. The remaining 12 fish were not detected at either fixed telemetry locations even though 3 fish were specifically identified during mobile radio tracking as in Bonneville Hatchery, the Wind River and the White Salmon River. Based on these findings, the fixed telemetry stations at LWSNFH near the fishing boundary and on Drano Lake were not 100% effective. Graphs of every fish detected by fixed telemetry sites can be observed in Appendix A.

Discussion of Objectives and Management Implications

Discussion of Objectives

Objective 1. Determine if hatchery brood stock collection is representative of the hatchery return.

Seventeen tagged fish were selected for brood stock during the ladder openings in 2004. While these recoveries are indicative of tagged fish being represented in the brood stock, there were too few recoveries to yield any statistical confidence (power < 0.7). Prior to the assessment, the number of fish tagged in each group were determined adequate for assessing if the hatchery ladder operations were selecting fish in representation of tagging activities but the number returning hatchery adults was larger than estimated.

Unfortunately, there were only 17 hatchery recoveries over 5 tagging dates. With just an increase or decrease of 1 recovery at the hatchery, results of assessing the representative collection of hatchery brood stock changes statistical significance. In 2005, the hatchery return was later than 2004 and capturing and tagging fish before October 19th was difficult. A total number of 440 upriver bright fall Chinook salmon were tentatively going to be tagged to assess whether the collection of hatchery brood stock was representative prior to October 19th, but low initial returns made that number impossible to achieve. The objective to determine if hatchery brood stock collection is representative of the hatchery return was not answered with statistical confidence during 2004 or 2005. A more representative collection of brood stock may have occurred in 2005 due to changes in ladder operation making collection occur into November. In 2004, collection ended in late October but return timing in 2004 was earlier than 2005.

Objective 2. Determine if intermittent ladder openings increase natural spawning and straying of Little White Salmon National Fish Hatchery returning adults.

The potential for fish of LWSNFH origin fish to move away from the hatchery area appeared after October 24th and again during first week in November based on the information summarized for the 2004 study year (Table 5). In 2005, no distinct pattern of movement away from the hatchery or Drano Lake is discernable but the two fish that were observed in Wind River and White Salmon moved shortly after October 25th, only one week after being captured and tagged with a radio transmitter (Table 9). Recoveries of tagged fish at adjacent tributaries was higher proportionally in 2004 during intermittent ladder operations than in 2005 with intermittent ladder operations and ladder opening after the third tribal fishing date.

In 2005, movement of tagged fish within Drano Lake was much more quantifiable than in 2004. Movement of tagged fish in 2005 across the sport and tribal fishing boundary

appeared to occur quite often with most fish being detected at the receiver on Drano Lake as well, sometimes over numerous dates (Receiver Record Graphs, Appendix A). The ladder operations in 2005 did seem to allow fish to move back and forth across the sport and tribal fishing boundary therefore providing opportunity for sport and tribal capture. Detection of tagged fish at either telemetry receiver was purposely designed to occur when fish were crossing in front of the fixed antennae of the receiver and not adjacent to the receiver. Unfortunately, detection of tagged fish at either of the fixed radio telemetry receivers was not 100% accurate. This finding is best observed by one fish (radio tag number 320-111) that was not detected by either receiver but was recovered at Bonneville Hatchery and had to obviously pass both receivers to leave Drano Lake after being tagged. Reviewing logging histories at both receivers, error codes on all the frequencies did occur but did not result in a positive detection on the receiver log history. Error codes were common on the receiver located near the fishing boundary and were logged on every frequency during most days. During mobile tracking on the Little White Salmon River, Service staff noticed Radio tags on an identical or close frequency in close proximity to one another would sometimes log as error codes on those frequencies. This could easily have occurred at the hatchery fixed receiver where fish are often numerous and in close proximity to one another. At the Drano Lake receiver, an underwater berm was found near the West shore of Drano Lake that appeared to block radio transmitter signals from being logged. This berm, in combination with fluctuating Bonneville Pool levels and turbidity, could have allowed tagged fish to pass without being logged. All other underwater areas in line with the Drano Lake receiver allowed radio tag signals to be detected. Even though detection was not 100% accurate at these locations, many detections were recorded and data suggests movement of fish from the area of LWSNFH out into Drano Lake does occur, in some cases often and possible for a period of days. Presumably, during a ladder closure at LWSNFH, upriver bright fall Chinook salmon will eventually move back out to Drano Lake and be available for sport and tribal capture during the early and mid portions of the fall return.

There does appear to be a distinct pattern in the recovery of LWSNFH coded wire tagged fish on spawning grounds and at the hatchery during the years of intermittent ladder operation (Table 9). A higher proportion of coded wire tag recoveries were reported on the Regional Mark Processing Center (RMPC) in the Little White Salmon River and Drano Lake, White Salmon River and Wind River and a corresponding decrease in the proportion of recoveries at LWSNFH. Examining Bonneville Hatchery coded wire tag releases, a large decrease in the recovery of coded wire tags occurs during 2002-2004 at LWSNFH (Table 10). Recoveries of Bonneville Hatchery coded wire tags in Little White Salmon River and Drano Lake, the White Salmon River and Wind River did not show large increases during the period of intermittent ladder operation.

Table 9. Percent recoveries of LWSNFH coded wire tagged releases by brood year and location. Coded wire tag recovery protocols of LWSNFH, carcass survey recovery protocols by Washington Department of Fish and Wildlife on tributaries, and Bonneville Fish Hatchery coded wire tag collection protocol have been consistent over return years presented. Intermittent ladder operations occurred at Little White Salmon NFH during 2002-2004. All CWT recovery data from Regional Mark Processing Center at www.rmhc.org (March 2006).

Return Year	LWSNFH	Bonneville Fish Hatchery	Little White Salmon River and Drano Lake	White Salmon River	Wind River	Total Recoveries = n
1995	98.2	0.9	0.0	0.9	0.0	110
1996	97.2	0.0	0.9	1.9	0.0	108
1997	92.2	0.0	4.7	3.1	0.0	129
1998	92.1	0.0	0.7	5.8	1.4	139
1999	95.7	0.0	2.4	1.9	0.0	207
2000	92.8	0.5	3.9	2.4	0.5	207
2001	88.8	0.0	3.6	7.7	0.0	169
2002	70.9	0.5	10.3	14.8	3.4	203
2003	56.7	0.5	16.3	20.2	6.4	203
2004	53.5	0.4	20.8	19.2	6.2	260
2005	Data not yet available on Regional Mark Processing Center					

Table 10. Percent recoveries of Bonneville Hatchery coded wire tagged releases by brood year and location. Coded wire tag recovery protocols of LWSNFH, carcass survey recovery protocols by Washington Department of Fish and Wildlife on tributaries, and Bonneville Fish Hatchery have been consistent over return years presented. All CWT recovery data from Regional Mark Processing Center at www.rmhc.org (March 2006).

Return Year	LWSNFH	Bonneville Fish Hatchery	Little White Salmon River and Drano Lake	White Salmon River	Wind River	Total Recoveries = n
1995	10.8	88.7	0.0	0.5	0.0	213
1996	5.9	94.1	0.0	0.0	0.0	255
1997	11.7	86.5	0.7	1.1	0.0	282
1998	19.8	76.5	0.6	1.9	1.2	162
1999	13.2	86.1	0.0	0.7	0.0	151
2000	19.0	77.8	0.5	2.6	0.0	189
2001	27.6	67.0	1.5	3.9	0.0	203
2002	3.4	89.9	1.1	2.6	3.0	268
2003	7.4	83.8	2.7	5.4	0.7	148
2004	2.3	94.2	1.6	1.6	0.4	258
2005	Data not yet available on Regional Mark Processing Center					

Objective 3. Determine the final destination of fish not allowed access to the hatchery or selected for brood stock.

During 2004, a large proportion of recoveries (24 of 45) did occur away from the hatchery or Drano Lake and were mostly within the White Salmon River (14 of 45). Comparatively in 2005, the bulk of recoveries occurred at LWSNFH or Drano Lake (25 of 28) and lone recoveries occurred within the White Salmon River, Wind River and Bonneville Hatchery.

Recoveries of tagged individuals did occur below Bonneville Dam during both years. Coded wire tag recoveries of Bonneville Hatchery production did occur at LWSNFH during brood stock collections in 2004 and 2005. The proportion of recoveries of Bonneville Hatchery production doubled from 2004 to 2005, potentially due to ladder operations (Figure 7), but this change in proportions seems negligible when considering the past 10 years of coded wire tag recoveries in brood stock (Figure 8). Coded wire tagging from both programs has remained consistent between both facilities in the past 5 years.

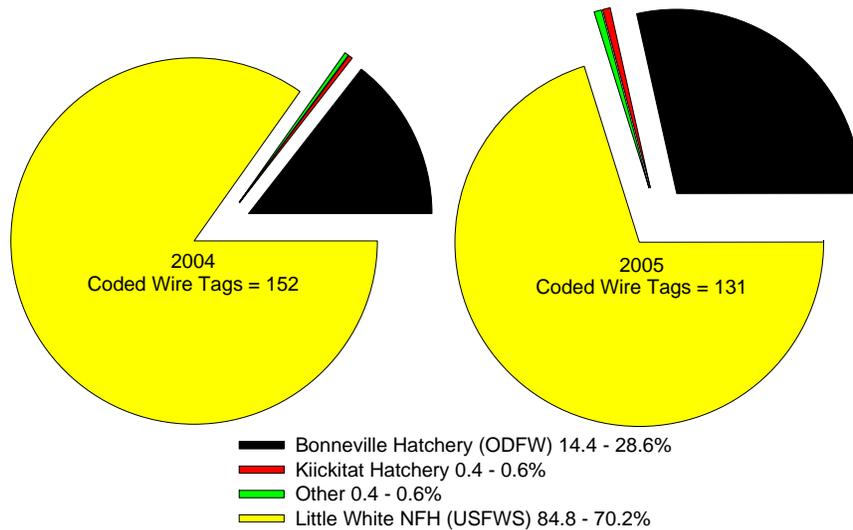


Figure 7. Coded wire tag (CWT) recoveries within brood stock collected from LWSNFH during 2004 and 2005. Percentages of CWT recoveries are listed and reflect changes from 2004 to 2005. Number of coded wire tags recovered is also given.

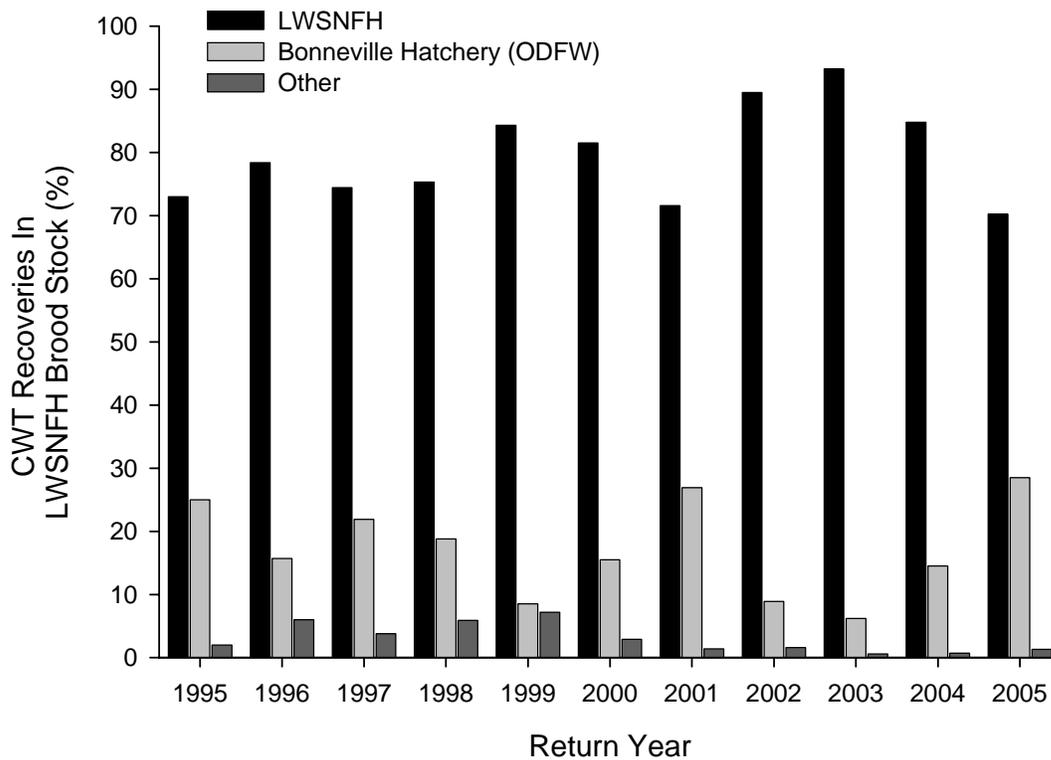


Figure 8. Percent of coded wire tag recoveries within Little White Salmon brood stock collections that are either LWSNFH, Bonneville Hatchery or from other programs for 1995-2005. The Other category includes fish from WDFW facilities, most often Klickitat Hatchery fish. Also included in the Other category are California Department of Fish and Game and some Snake River program fish from both state and tribal agencies. Intermittent ladder operation occurred at LWSNFH during 2002-2004.

With a number of Bonneville Hatchery returning adults moving to LWSNFH most years, the fish that were tagged and released at LWSNFH and moved downstream or below Bonneville may have been Bonneville Hatchery returning adults and not production from LWSNFH.

Management Implications

Little White Salmon NFH upriver bright fall Chinook salmon provide an ideal terminal fishery in nearby Drano Lake, allowing both sport and tribal harvest in an area that does not support naturally spawning ESA-listed stocks of fish (USFWS 2004). A total of 7,758 upriver bright fall Chinook returned to LWSNFH in 2005 with changed ladder operations. Considering a similar tribal catch in Drano Lake between years of the study (3,571 in 2004, 3,866 in 2005), a comparable number of fish most likely returned to the hatchery in 2004 when the ladder was not open through the end of the return. If the ladder operation was to remain consistently open early in the return, there may be a consequential reduction in the number of fish captured by sport and tribal anglers. Providing a fishery benefit is one of the primary purposes of the LWSNFH. Harvest of fall Chinook salmon in the sport and tribal fishery also reduces the potential for fish to leave Drano Lake and compete with native fish on spawning grounds. Additionally, the harvest of fish by sport and tribal anglers reduces the hatchery personnel demands for

surplus operation. Ideally, the facility would receive enough fish for brood stock needs and all other fish would be harvested. The potential for more fish to be harvested does seem attainable and would reduce the opportunity for hatchery produced upriver bright fall Chinook salmon to spawn in local tributaries.

The 2005 ladder operation appears to have reduced the potential impacts of LWSNFH production fish attempting to spawn in the White Salmon River. The ladder operation protocol used in 2005, intermittent openings until the completion of the third tribal fishing date in October, will be instituted by LWSNFH as requested by NOAA-Fisheries.

As radio tracking information detailed in 2004, and in particular with two tagged fish in 2005, there is still potential for hatchery returns to be in the area of the hatchery while the ladder is open, yet move to an adjacent tributary and attempt to spawn. In future years, USFWS staff will continue to monitor spawning ground recoveries reported to the RMPC and contact WDFW and PSMFC staff about spawning ground recoveries of Little White Salmon production. Service staff also plan to present study findings to Yakama Nation fisheries staff and, if requested, tribal fisherman to inform them of fish movements and potentially improve capture of upriver bright fall Chinook during the fall fishery. The potential for targeted fisheries on upriver bright fall Chinook salmon also exists within White Salmon River and may be beneficial as a conservation tool for reintroduced, protected, or listed populations of tule fall and spring Chinook salmon.

With the pending removal of Condit Dam on the White Salmon River in 2008, the future conservation and restoration of listed tule fall Chinook salmon and spring Chinook salmon depends on assessing potential interactions of upriver bright fall Chinook on spawning grounds. Upriver bright fall Chinook salmon arrive near the end of the tule fall Chinook salmon return in the Columbia River Gorge. Superimposition of tule fall Chinook salmon redds with upriver bright stock is identified within the White Salmon subbasin plan (Normandeau Associates 2004, Table 10). In 2006, a joint proposal was submitted to the Northwest Power and Conservation Council 2007-2009 funding cycle with a section addressing the production of upriver bright fall Chinook and tule fall Chinook salmon in the White Salmon River (Proposal 200712200). The products of this study would address salmon reintroduction and conservation issues within the White Salmon River and additionally may influence operations of Spring Creek and Little White Salmon National Fish Hatcheries.

Table 10. Two objectives located in Table 33 – *Strategies and assessment opportunities to provide anadromous fish access above Condit Dam* and Table 34 – *Strategies for improving anadromous habitat above Condit Dam of the White Salmon Subbasin Plan* (Normandeau Associates 2004).

Strategy for access above Condit Dam Biological Processes	Life Stages	Cause/Working Hypothesis (Reference)	Biological Objective (Reduce/Eliminate Negative Causes, or Improve/maintain positive causes)	Key Assumptions	Confidence effect is actually occurring and significant	Confidence in relationship between effect and biological response	Confidence project will meet biological objectives	Recommended Actions	Recommended Reaches
Maintain genetic diversity of unique populations below Condit Dam if removal strategies put species at risk.	All	The primary risk to population and genetic structure resulting from modification of removal of the dam is the expected short-term effects on existing habitat downstream of the dam. Spawning may be lost for one or more years due to habitat degradation.	Develop population and genetic diversity maintenance program in the event the habitat below dam is not functional for some period of time.	This assumption is based on the proposed dam removal option in the Settlement Agreement. Other anadromous access options have different risks.	High certainty that if dam removal occurs as planned population spawning below Condit Dam will have high incubation losses during their first year and possibly subsequent years. Incubation losses will be reduced as sediment is flushed and habitat stabilizes	High Certainty that increased sediment loads will decrease egg incubation survival.	WDFW has high certainty that the combination of protection strategies will be successful based on previous hatchery intervention and reintroduction efforts. Klickitat County's biologists dispute this conclusion.	Primary: 1) Protect unique Tule fall Chinook Program by maintaining brood stock at USFWS Spring Creek Hatchery. 2) Protect unique O. mykiss in above Condit Dam for possible steelhead recolonization. 3) Assess coho population structure to determine best options Secondary: 1) Protect population structure and abundance of local salmon and steelhead population to serve as donor stocks. These include Klickitat, Hood, and Wind River steelhead and Chinook stocks.	All
Conduct study to assess the degree of competition between natural bright and tule Chinook populations	Juvenile and adult	Species interactions occur between the native tule and introduced upriver bright fall Chinook salmon	Decrease the potential competition between tules and upriver brights.	Introduced upriver bright fall Chinook salmon have become established in the White Salmon River	High certainty this is occurring. It is unclear if this is a significant limiting factor.	Moderate certainty of the extent of superimposition	Low certainty that this effect could be changed give the US v OR agreements	Primary: See population monitoring program in the Condit Dam Access Section.	Below Condit Dam.

Acknowledgements

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This assessment addresses U.S. Fish and Wildlife Service objectives relating to operation, monitoring and evaluation of Little White Salmon National Fish Hatchery upriver bright fall Chinook salmon program. This assessment also addresses Performance Standards and Indicators identified within the Little White Salmon Hatchery and Genetic Management Plan (2004) submitted to NOAA-Fisheries Sustainable Fisheries Division.

Submitted by:

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Tim Roth, Deputy Project Leader, CRFPO

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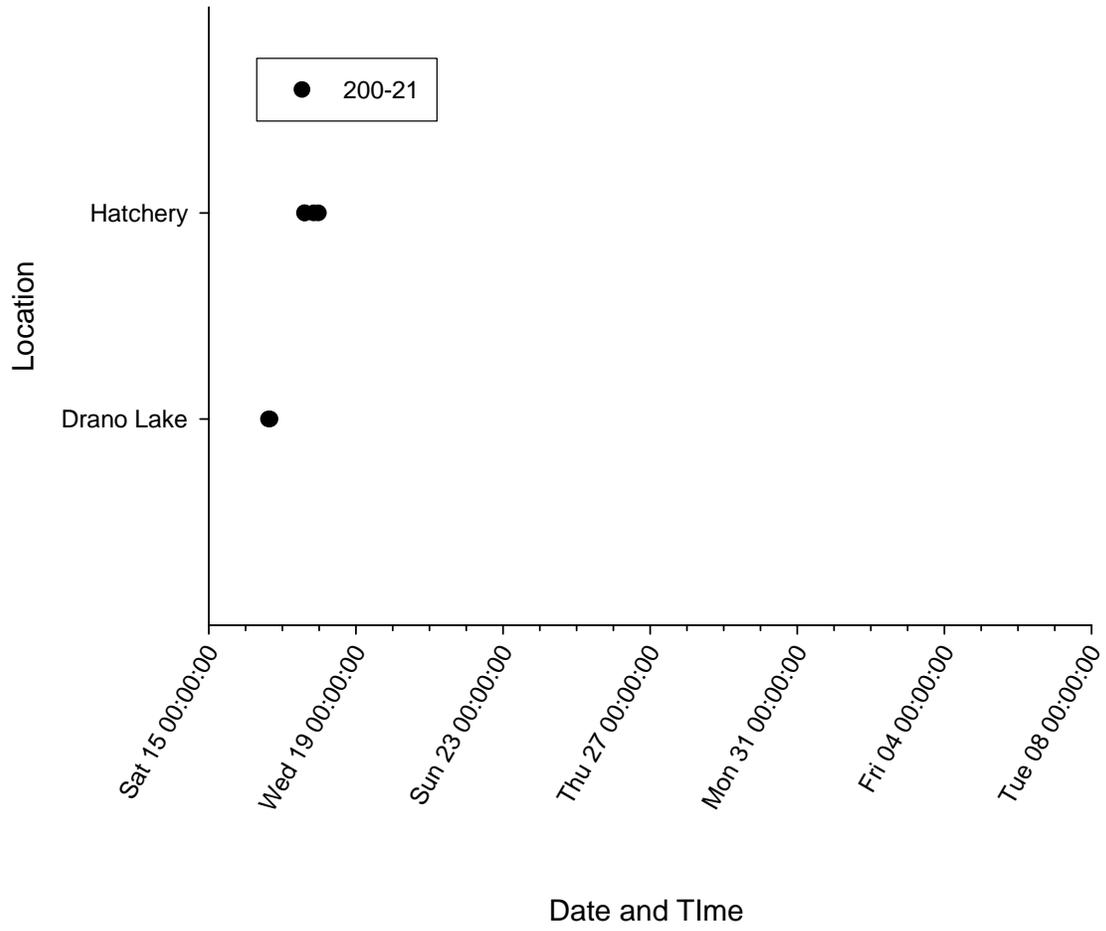
Speros Doulos, Project Leader, Little White Salmon/Willard NFH

A signature page is on file at the Columbia River Fisheries Program Office in Vancouver, WA. Contact Administrative staff at (360) 604-2500 to receive a signed copy of this report.

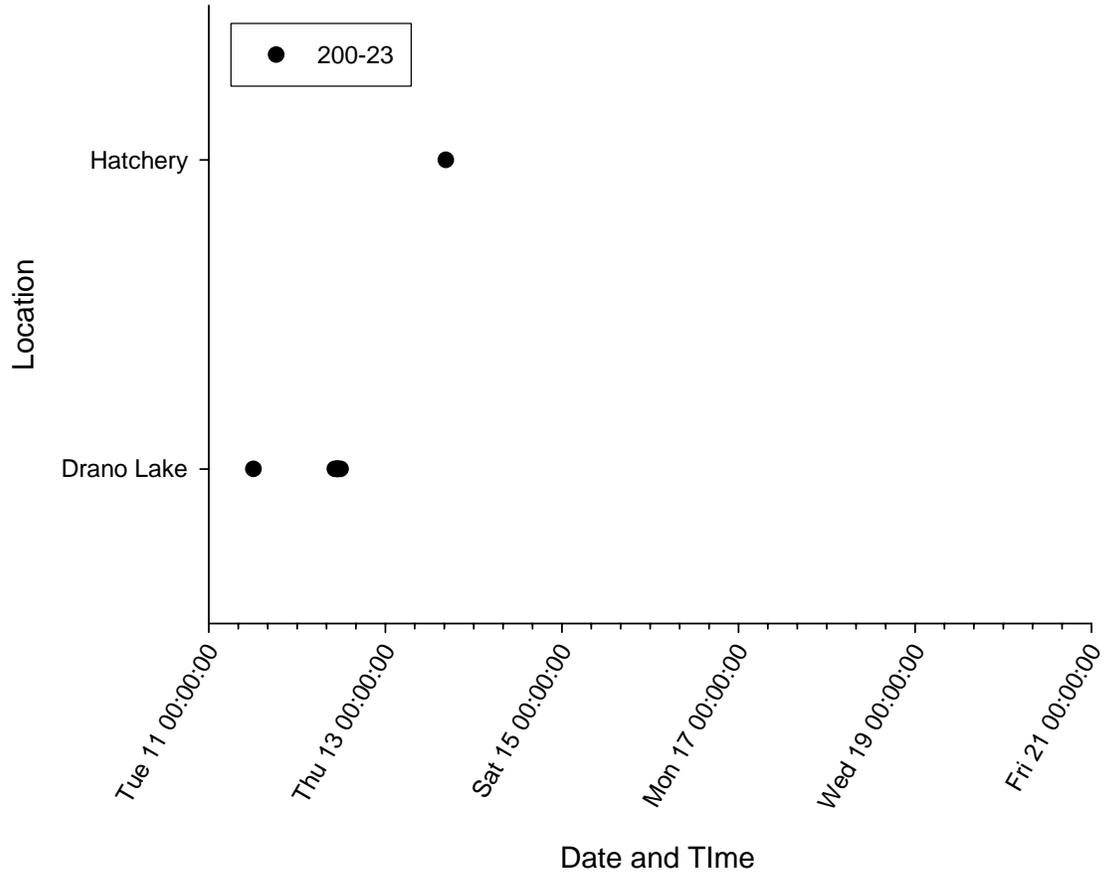
Appendix A

Telemetry receiver records for radio tagged upriver bright fall Chinook salmon during 2005 at Little White Salmon NFH. Locations of telemetry stations were near the tribal and sport fishing boundary (Hatchery) and on the Eastern side of Drano Lake (Drano Lake). Length, sex and dates of tag operation until capture or end of the study (November 7th) are provided. Figure 3 provides a detailed map of receiver locations. Movements of radio tagged fish during mobile tracking can be found in Table 9.

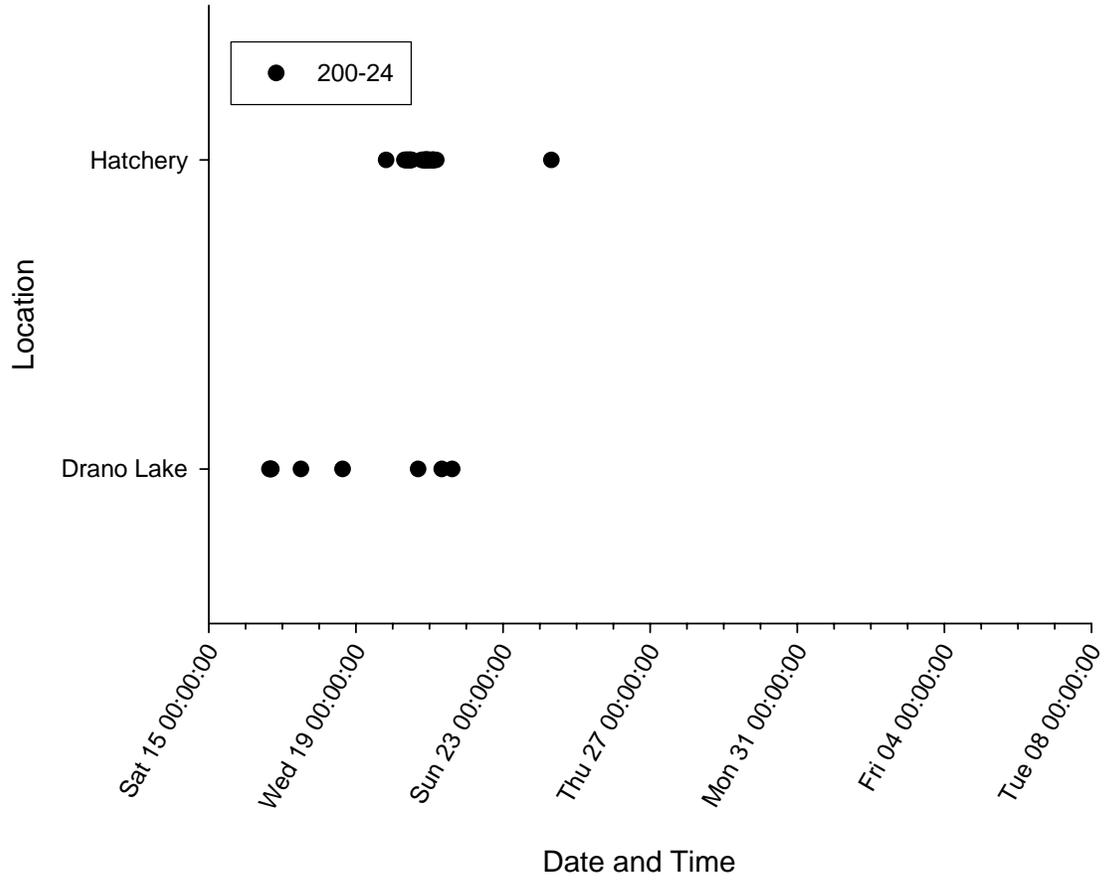
Tag Number 200-21
Male FL = 92 cm
10/15 to 11/7



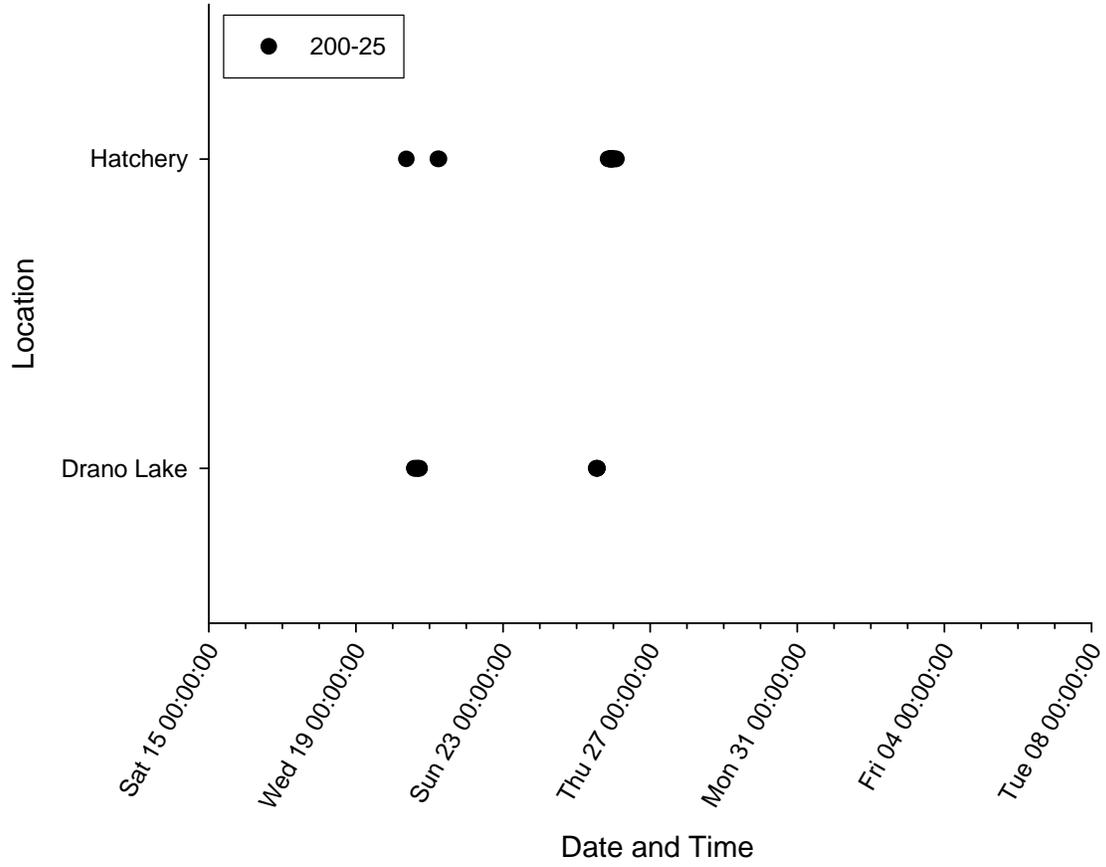
Tag Number 200-23
Female FL = 82 cm
10/11 to 10/20



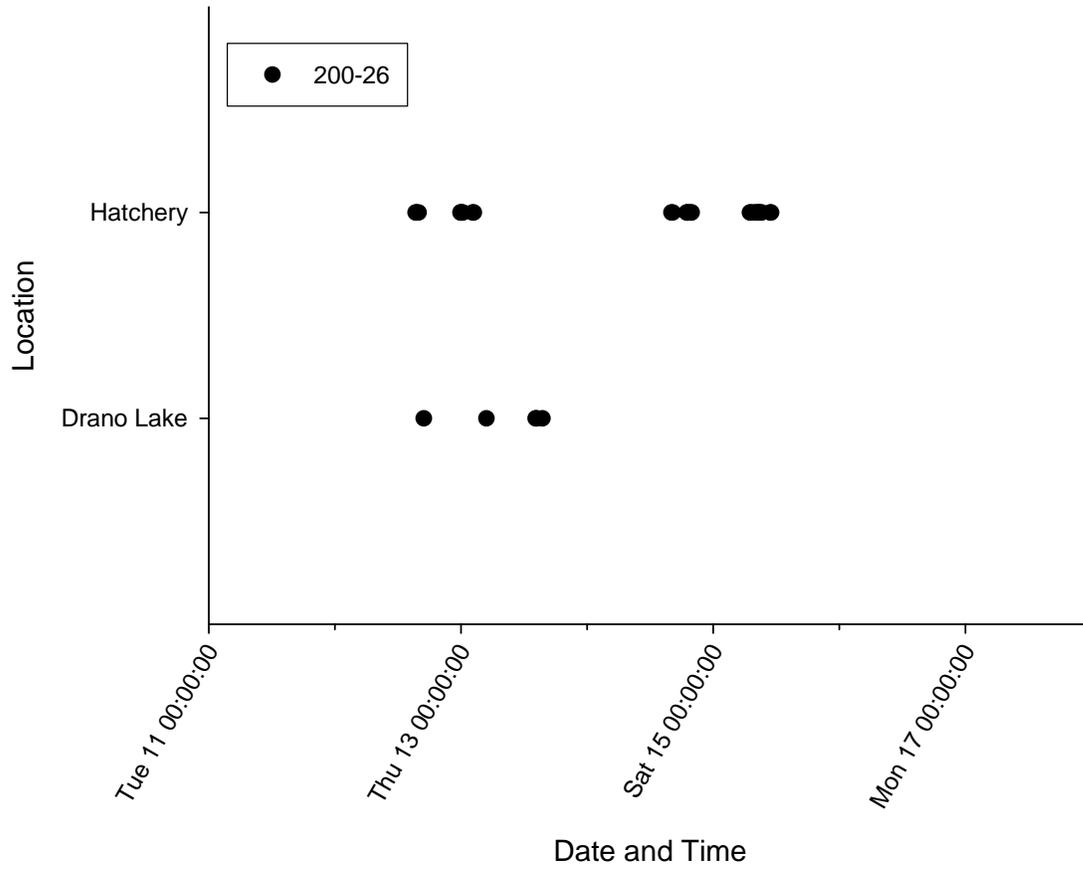
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10/15 to 11/7



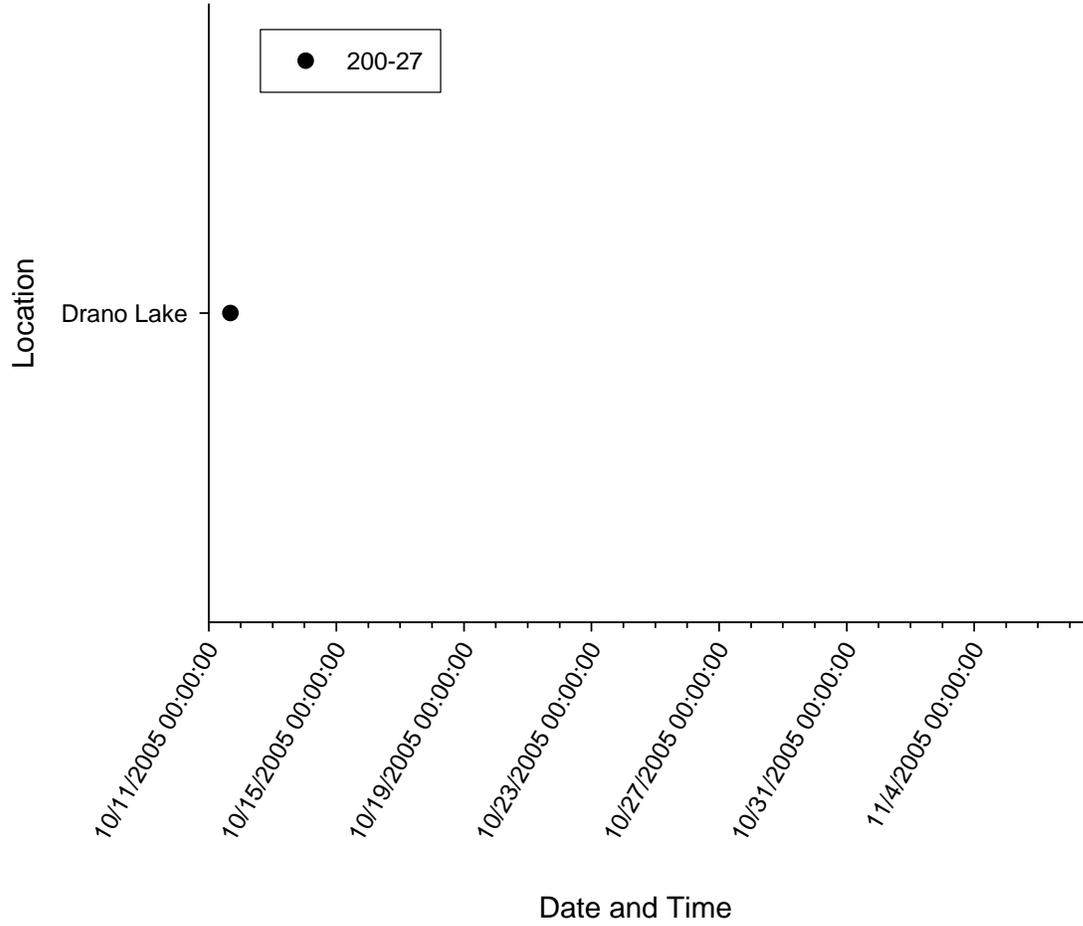
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Male FL = 78 cm
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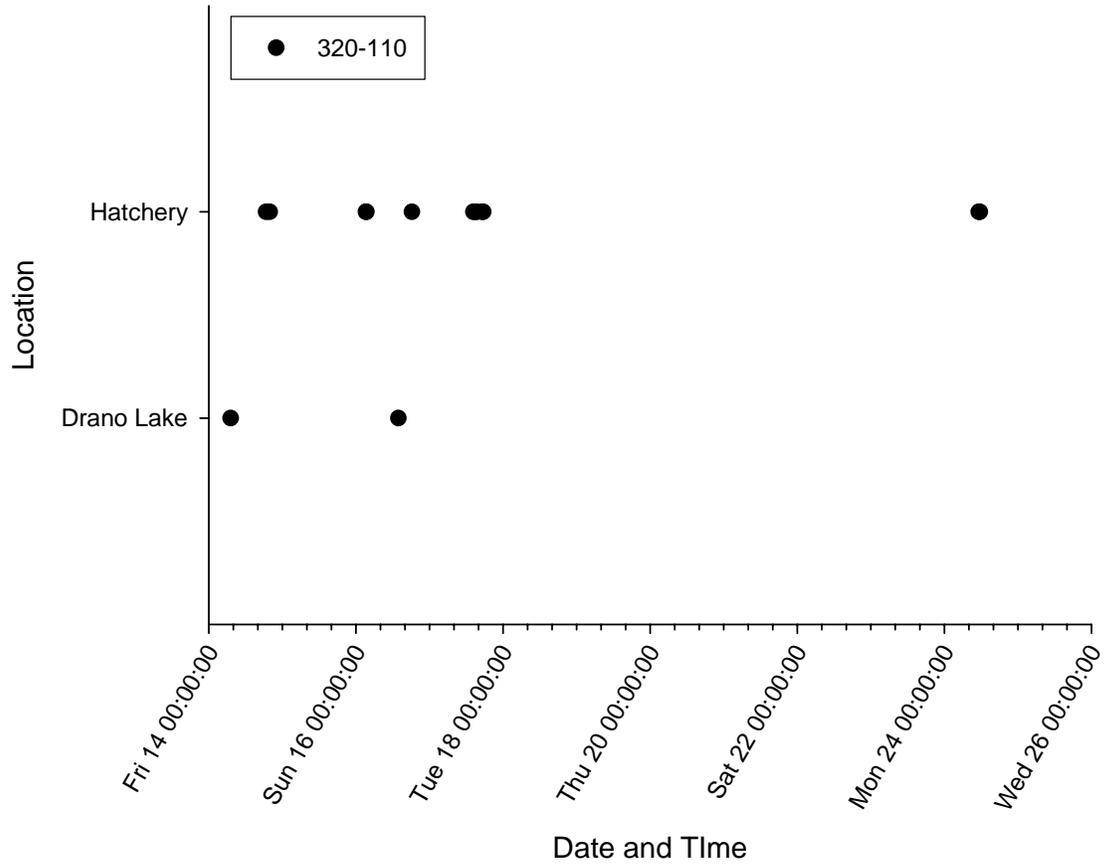
Tag Number 200-26
Male FL = 96 cm
10/11 to 10/17



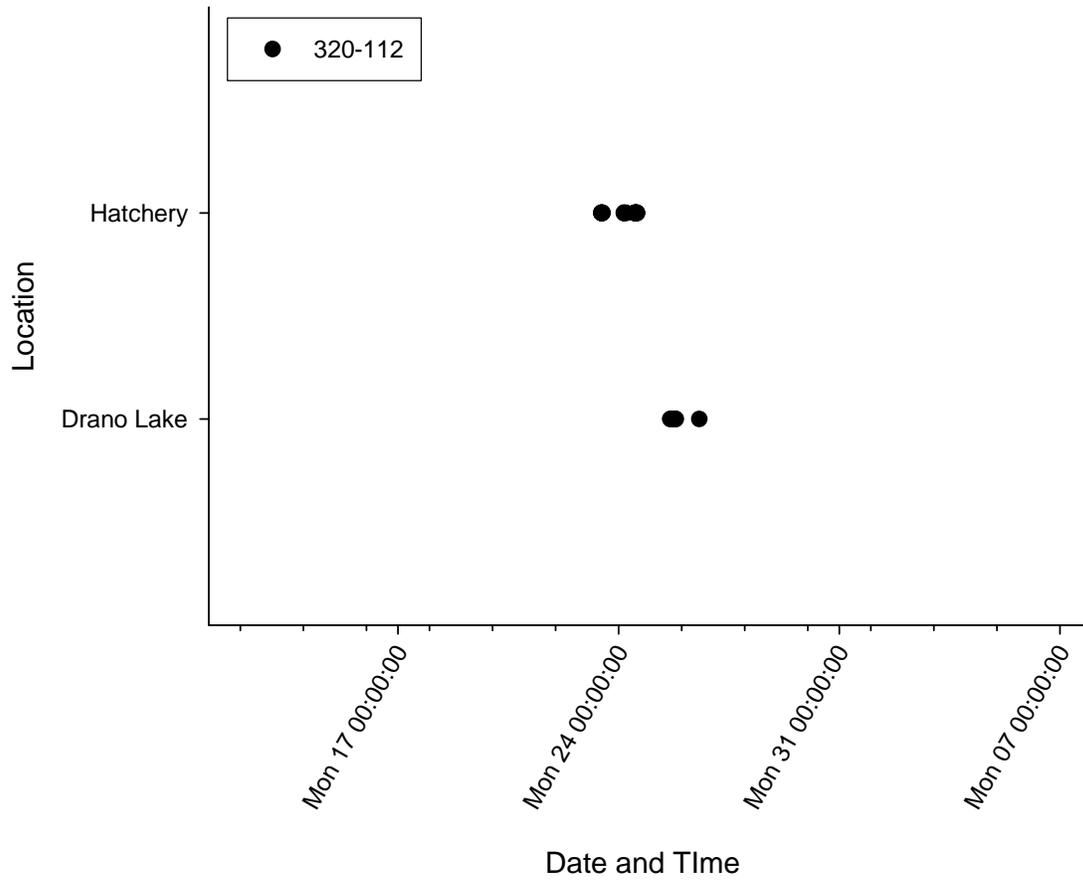
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10/11 to 11/7



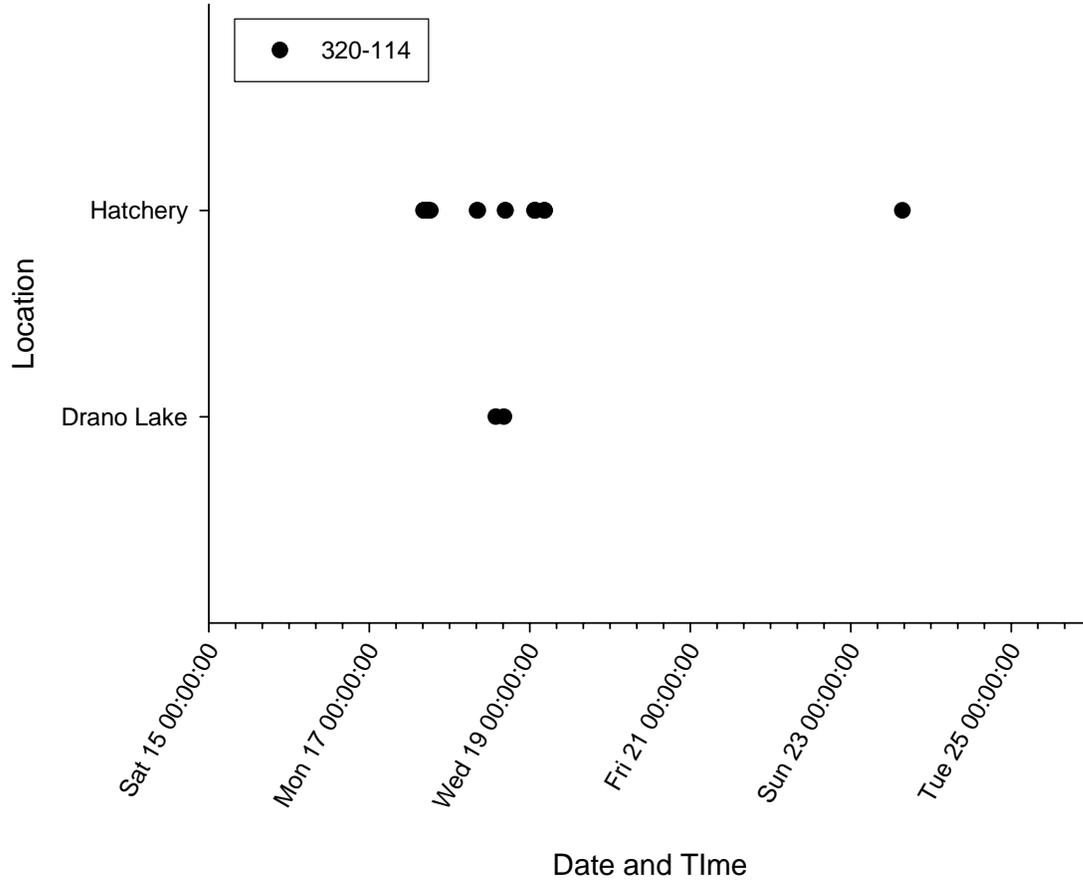
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Female FL = 88 cm
10/14 to 10/25



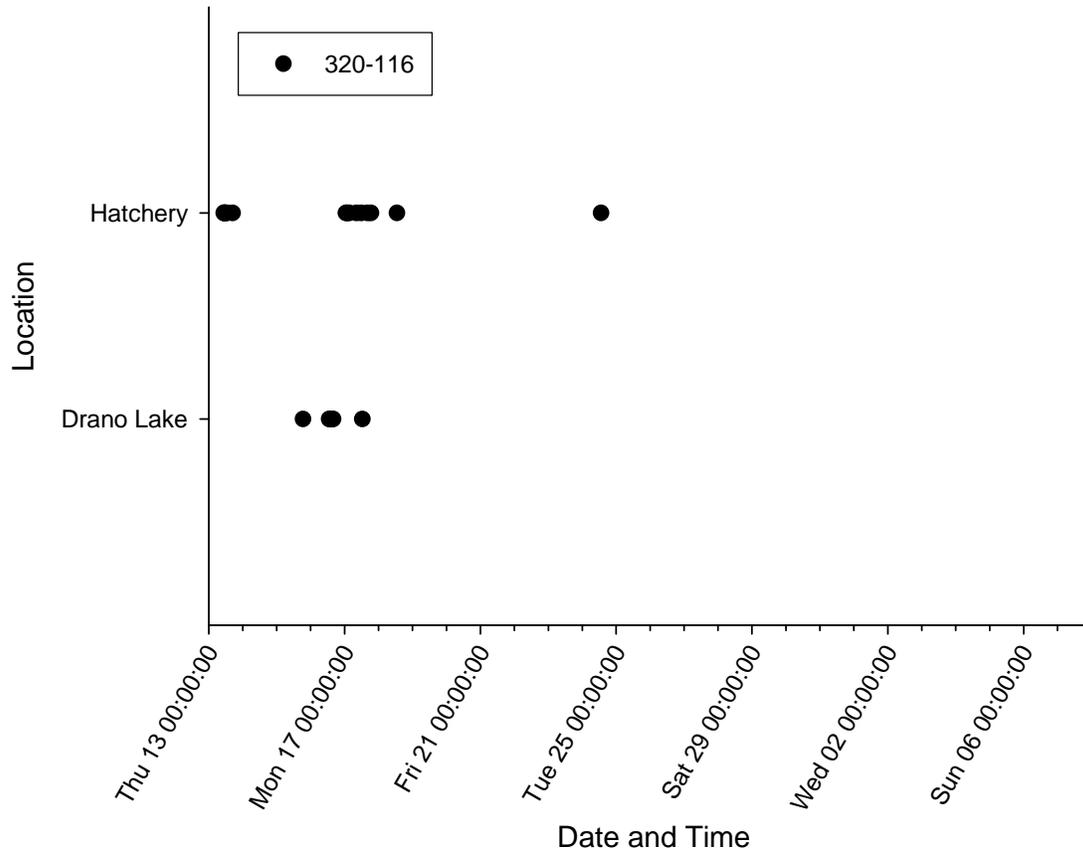
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Female FL = 95
10/11 to 11/7



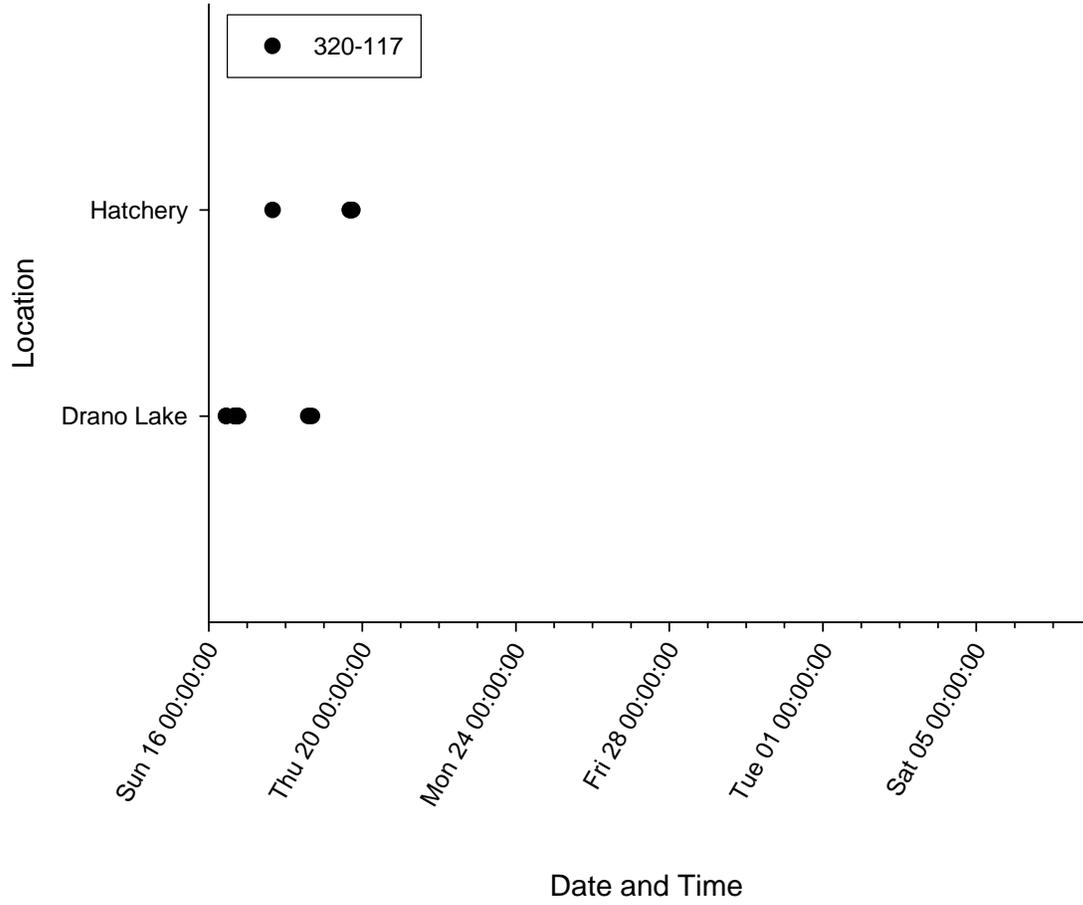
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10/15 to 10/25



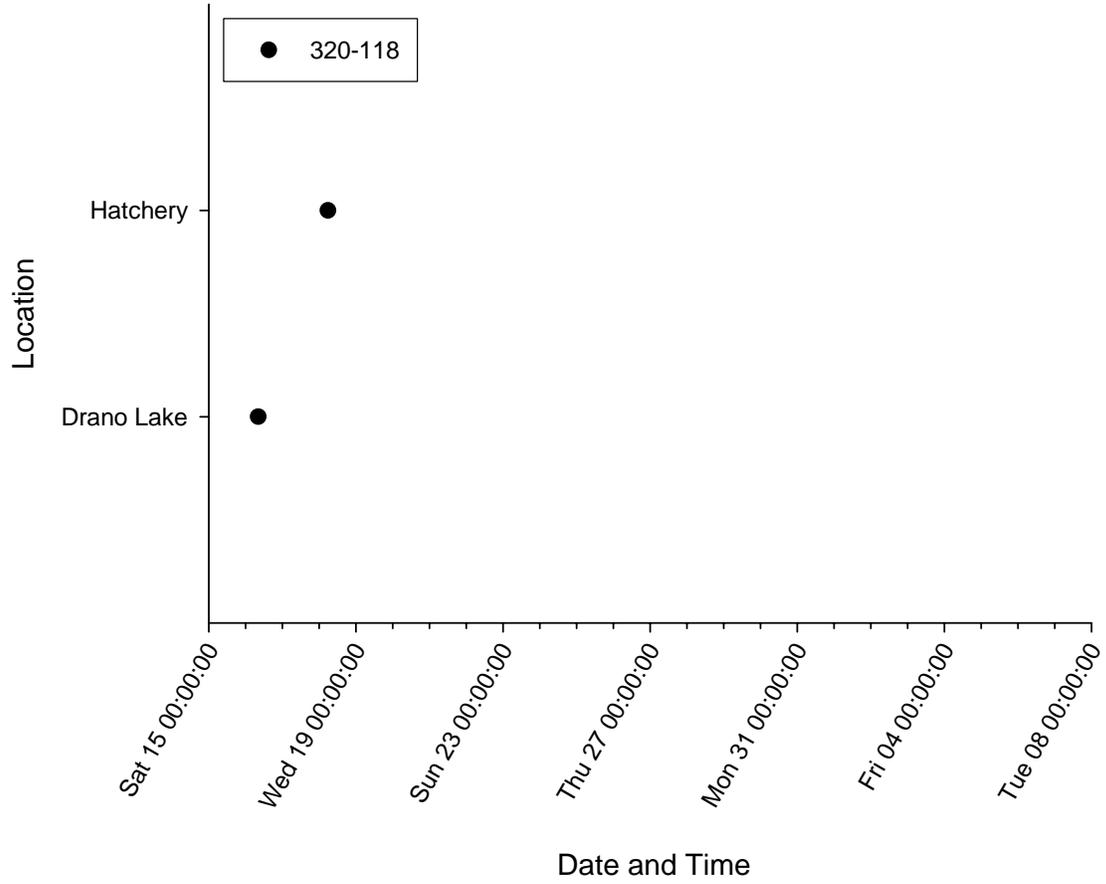
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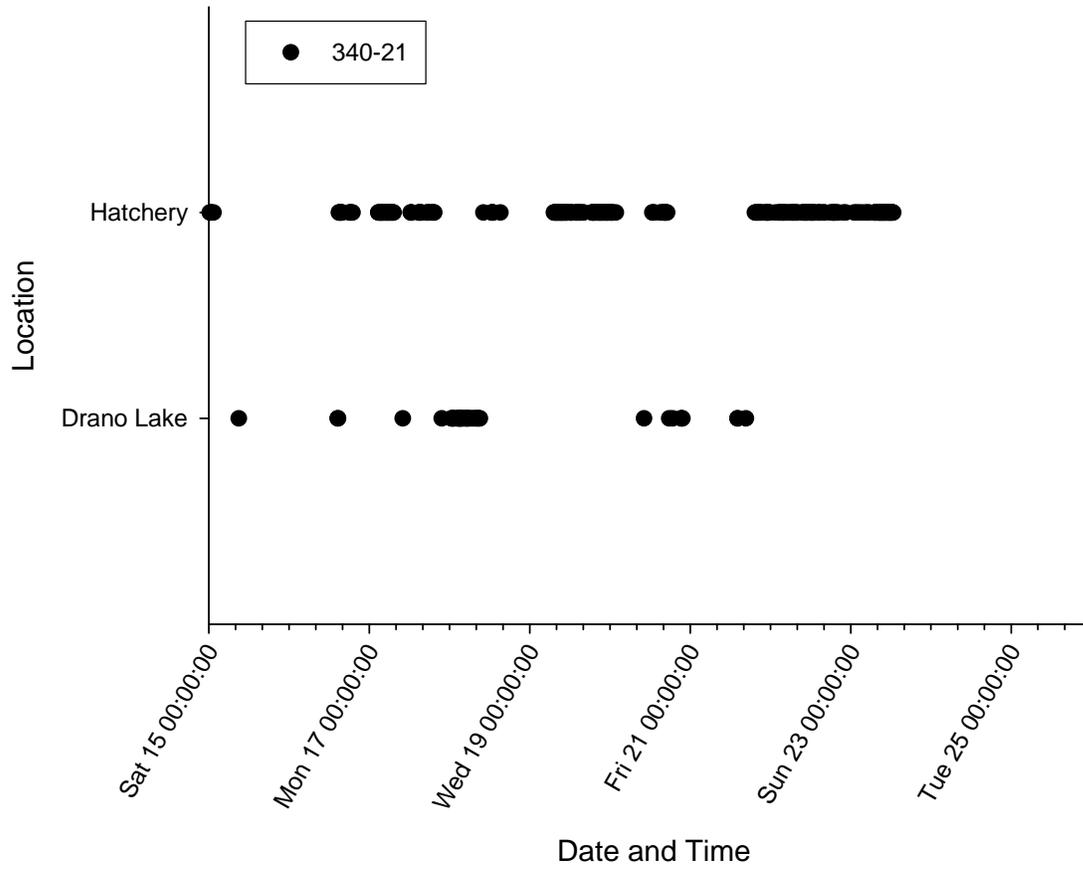
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Female FL = 81 cm
10/16 to 11/7



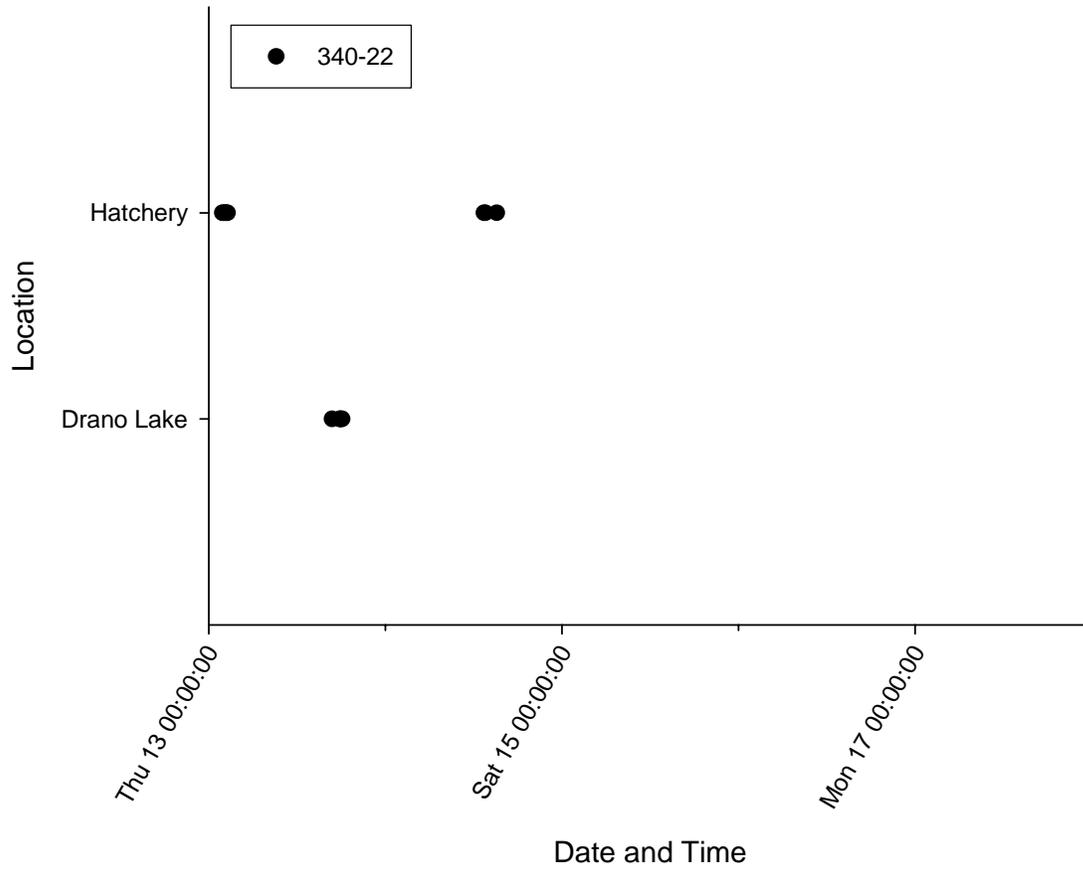
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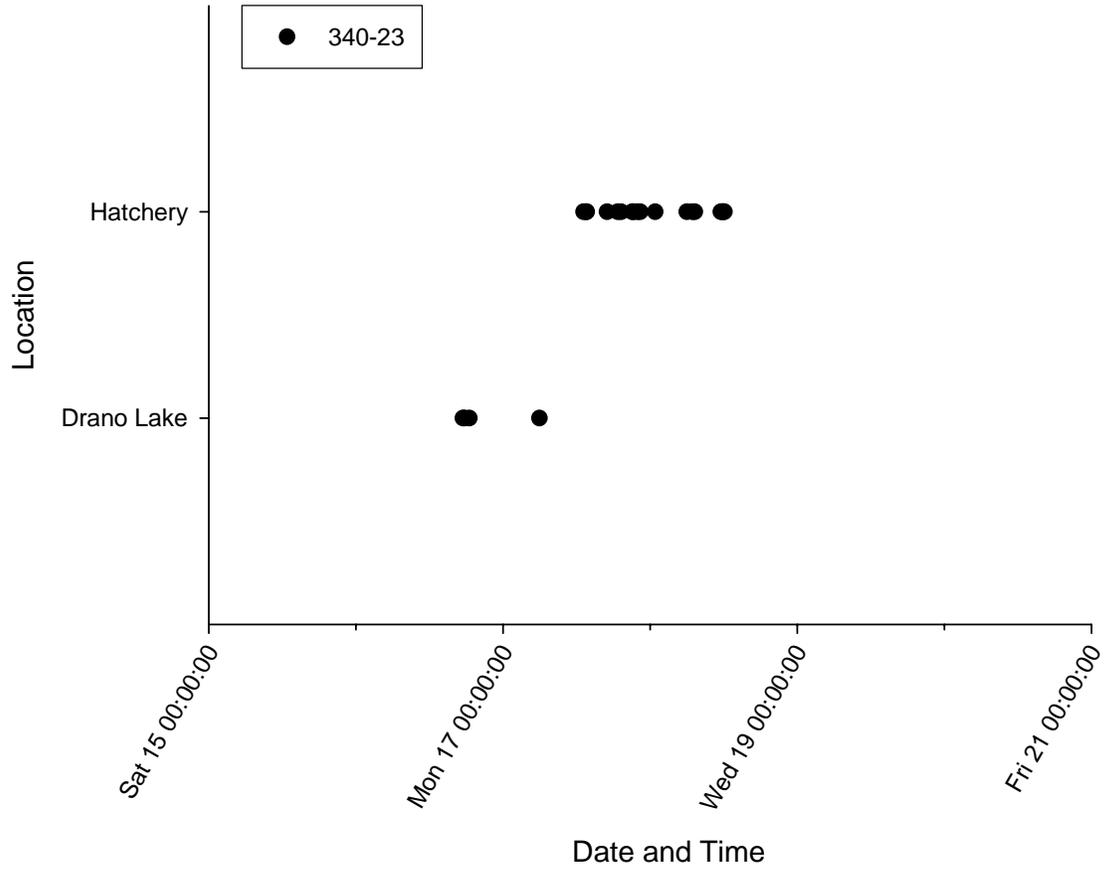
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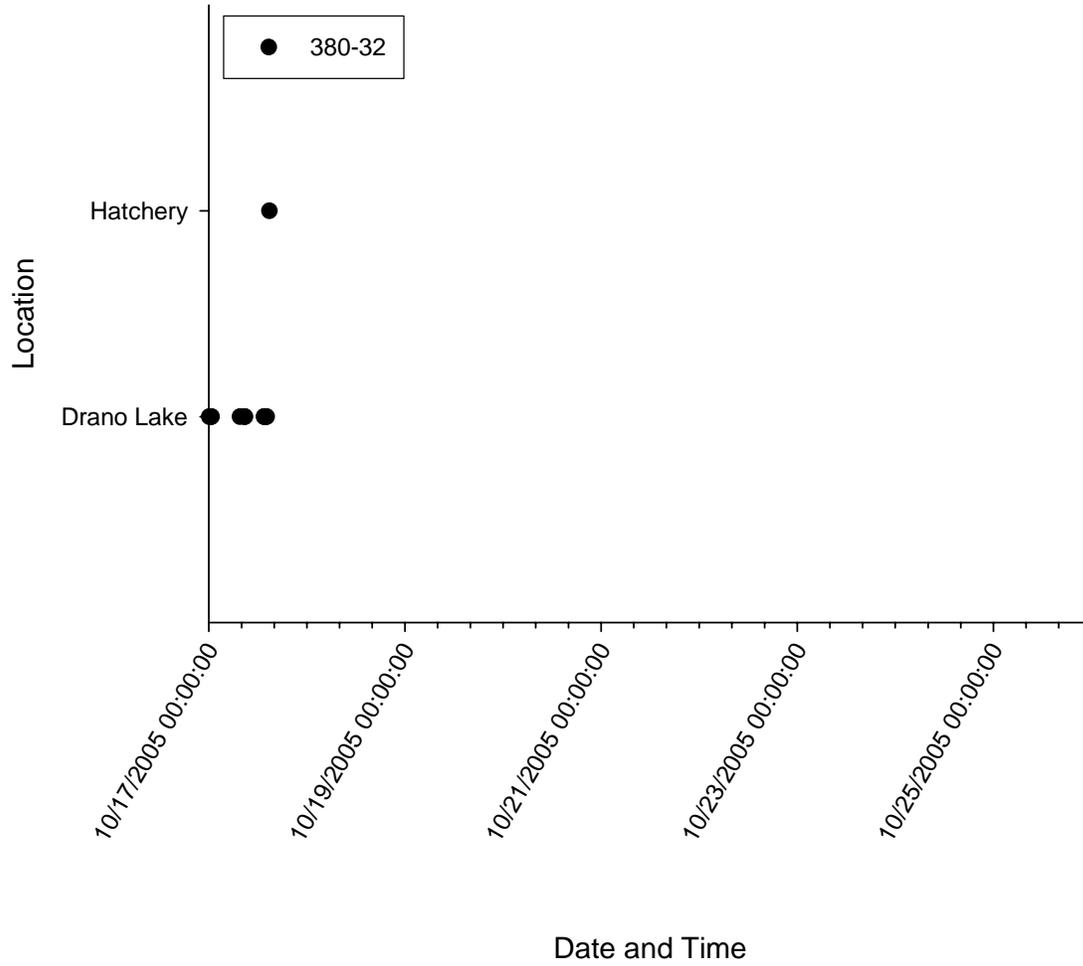
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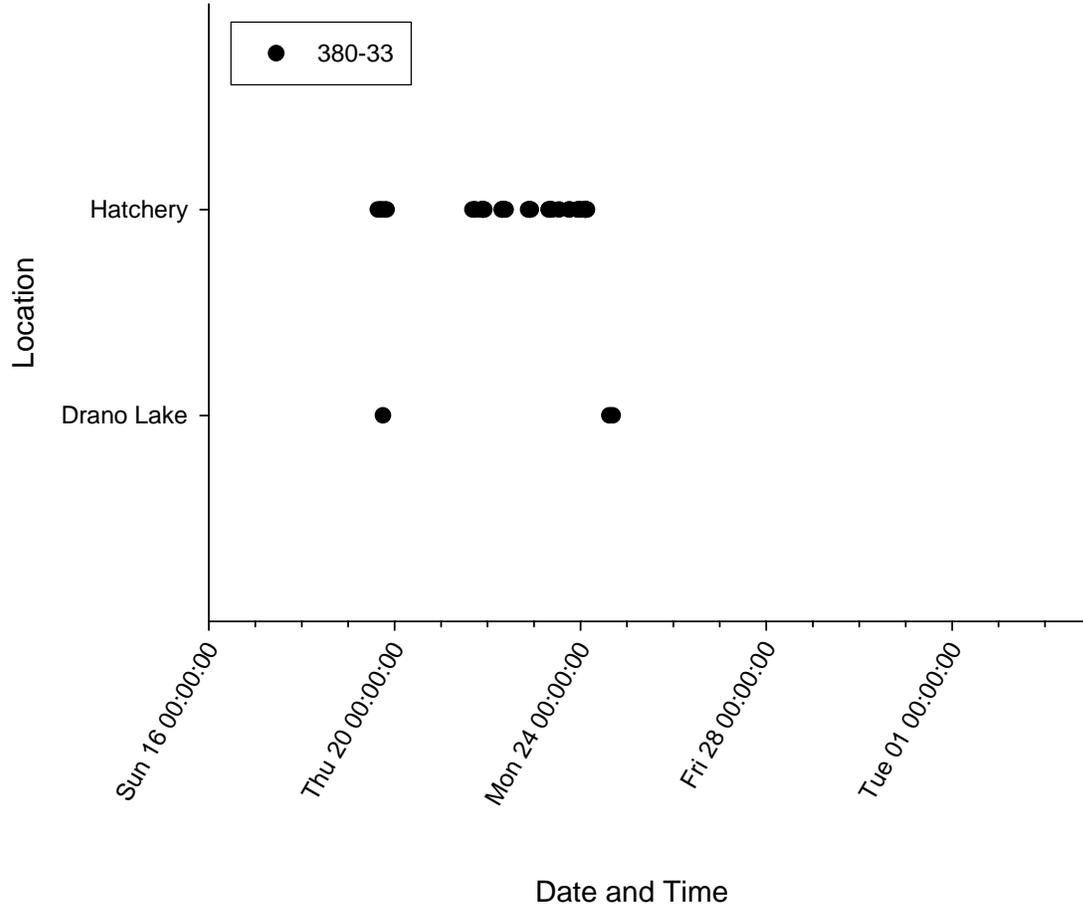
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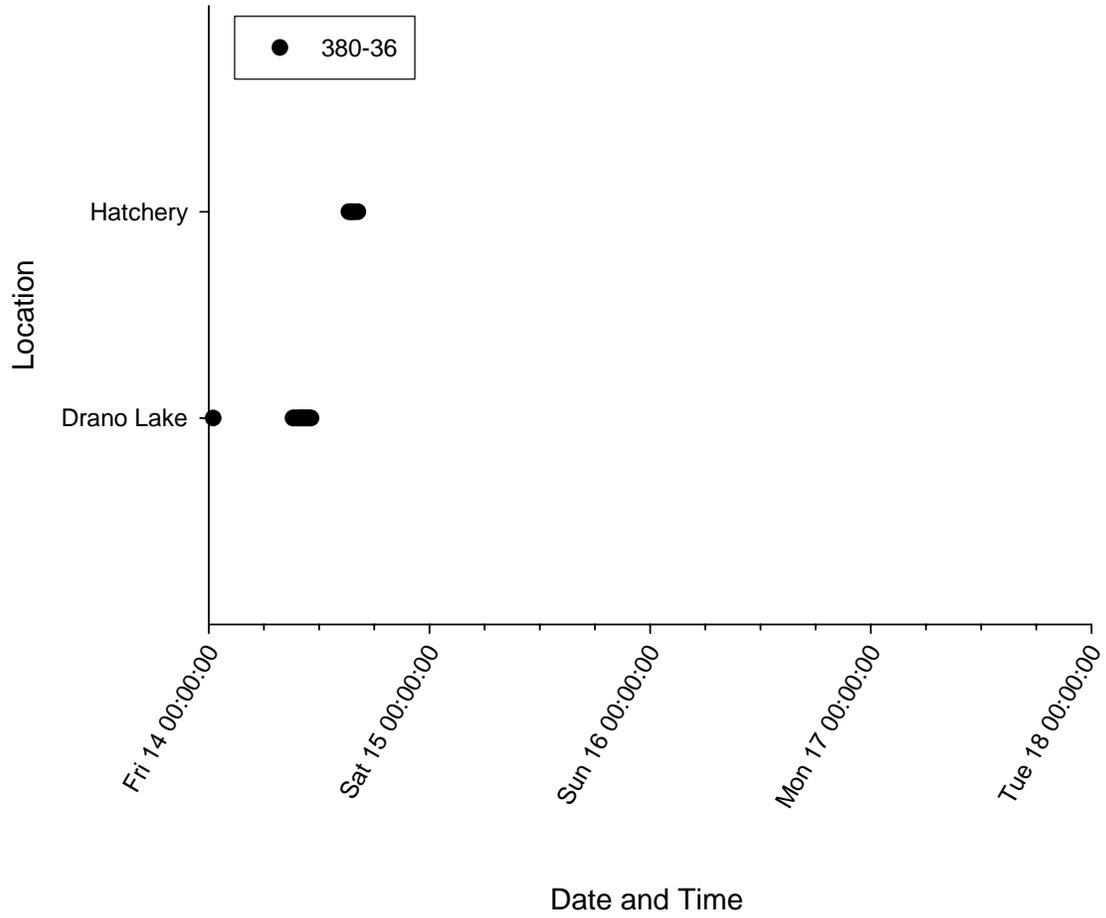
Tag Number 380-32
Male FL = 86 cm
10/17 to 10/25



Tag Number 280-33
Female FL = 82 cm
10/16 to 11/3



Tag Number 380-36
Male FL = 91 cm
10/14 to 10/17



Tag Number 380-37
Male FL = 64 cm
10/15 to 10/25

